I/O News

Budget Graphics for the Z-2D
Expert System in Occupational Safety
A Microcomputer-Based Radar System

THE OFFICIAL PUBLICATION OF THE INTERNATIONAL ASSOCIATION OF CROMEMCO USERS

Volume Two, Number Five

Single Copy Price $7.50

C-10 Unveiled At NCC

Cromemco Introduces the New Standard of Performance to the Low Cost Computer Marketplace

The forerunner of a new generation of personal computing systems was heralded at the National Computer Conference when Cromemco unveiled its revolutionary C-10 system.

The C-10 is what company president Dr. Harry Garland describes as a "full-capability" system. "It has a full 25 line by 80 character graphics display, which is the type of feature that you see on much higher-priced systems," he points out. "It also has the full power of the Z80A microprocessor operating at 4MHz with 64 kilobytes of RAM, and a 12-inch green phosphor CRT." The $1785 C-10 Super Pak system also includes a double-sided, double-density disk drive, a detachable keyboard, an RS232 serial port, a parallel port, RS232 modem port with full handshake capability and an impressive array of software packages. The software packages include CDOS (CP/M compatible), Structured BASIC as its high-level language, a complete word processing package, and a spread-sheet calculator program.

To make it even more affordable, Cromemco will offer the pieces comprising its Super Pak and deluxe word processing packages as separate items, with no single item costing more than $995. The C-10 personal computer itself, consisting of the processor, CRT display, and serial and parallel ports, will be priced at $995. The model CKBA keyboard

Continued on page 8

Interrupt Processing: A Tutorial

by Doug McBride & Jim Graham

Introduction

This article is intended to serve as an introduction to interrupt processing in general, and more specifically, interrupt processing using Cromemco hardware and software facilities. The implementation of a periodic interrupt service routine under CDOS will be discussed as an example of how interrupts can be easily implemented in certain system environments.

Background

The concept of interrupt processing is an important one, but due to

Continued on page 12

COGO: A Civil Engineering Coordinated Geometry Program

by Jan Van Campenhout

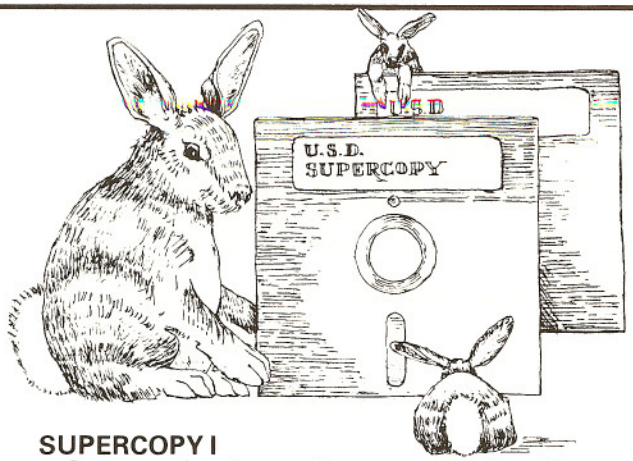
Description and Features

The General Structure of COGO

The COGO package is an interactive program written in Cromemco's Structured BASIC, and is composed of eight overlay modules listed below:

COGO.SAV (the root module)
COGO1.LST
COGO2.LST
COGO3.LST

Continued on page 10



SUPERCOPY

USD offers two FAST copy utilities, SUPERCOPY I & SUPERCOPY II. Either version produces fully-verified, error-free diskette duplicates with amazing speed—less than 140 seconds for an 8" DSDD 1.2 megabyte diskette.

SUPERCOPY I

Supercopy I copies any Cromemco diskette while operating under Cdos, including CROMIX diskettes. Provides readout of errors and their locations, should they occur. Many options.

SUPERCOPY II

Copies and/or Initializes any Cromemco diskette while operating under Cromemco Cdos OR Cromix. Uses extensive automatic error handling techniques to produce error-free copies with or without operator intervention. Many options are available, all of which may be customized during initial use for future automatic operation. The ultimate diskette duplication utility for both Cdos and Cromix. Allows duplication of previously "uncopyable" diskettes.

WHAT YOU GET

Supercopy I or Supercopy II on 5 or 8 inch SSSD diskette, comprehensive Users Guide, one year's free software support.

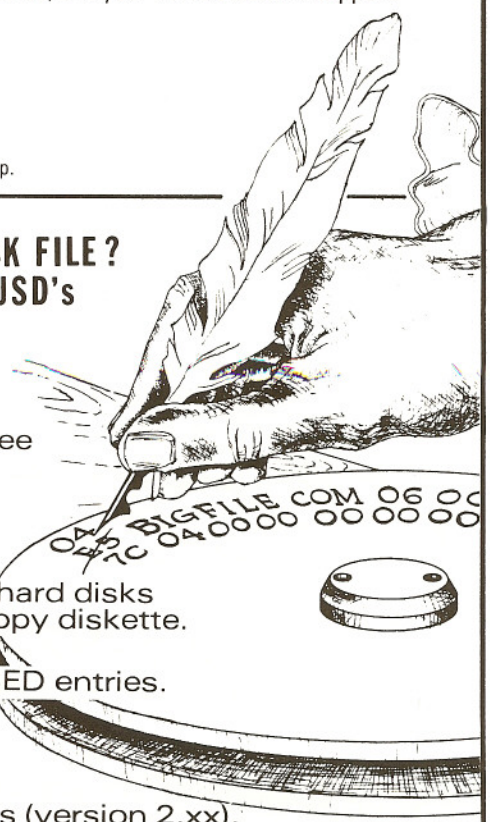
SYSTEM REQUIREMENTS

Cromemco computer operating under Cromemco Cromix or Series 2 Cdos.

WHAT IT COSTS:
- SUPERCOPY I — $49.50
- SUPERCOPY II — $95.00
- New York residents add 7%
- Make checks payable to U.S. Dynamics Corp.

RESTORE

ERASED THAT IMPORTANT HARD DISK FILE? RESTORE IT IN SECONDS WITH USD's RESTORE.



WHAT YOU GET

Restore.Com and Edir.Com on SSSD 5¼ or 8 inch diskette, comprehensive Users Guide, one year's free software support.

WHAT IT DOES

Restore.Com restores erased files on Cromemco's hard disks (HDD-11, HDD-22, Z2-H, etc.) or any Cromemco floppy diskette.

Edir.Com displays an alphabetical directory of ERASED entries.

SYSTEM REQUIREMENTS

Cromemco computer operating under series 2 Cdos (version 2.xx).

WHAT IT COSTS:
- $95.00 For immediate air mail shipment.
- New York residents add 7%
- Make checks payable to U.S. Dynamics Corp.

For INFORMATION or SUPPORT: Call collect.
Ask for software engineering.
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30 YEARS AT THE USD LEADING EDGE

HOW TO ORDER
Call collect or write. If calling, place calls during normal business hours, EST. Ask for software sales.

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MORE POWER TO YOU

With

"E-x-p-a-n-s-i-o-n Packs"

From The Leading Cromemco Dealer In America

16-Megabyte Hardpack **$8,995**

Cromemco users can now have 16-megabytes of storage with Control Data Corporation's Winchester technology Lark hard disk drive. Back-up storage is provided with 8-megabytes of fixed memory and 8-megabyte removeable cartridge.

Graphics Plotter Hardpack **$1550**

The new Hewlett-Packard 7470A 2-pen plotter is a perfect complement to any Cromemco computer system. Designed with an RS-232 interface for easy connection, the "Sweet Lips" plotter is engineered with H-P excellence to perform reliably for the life of your system.

MCS MENUtility Softpack **$195**

This Menu generator program provides a friendly, user-oriented menu system for CROMIX[1] users. Any desired set of application programs may be selected from an automatically produced "menu."

Matchmaker™ Softpack **$195**

Selectively search CROMIX and CDOS[1] ASCII files, match key words, and document their occurrence within each file. This convenient, time-saving program is extremely useful in a wide variety of applications ranging from researching a data base to performing powerful word processing tasks.

96-Megabyte Hardpack **$14,995**

Control Data Corporation's Phoenix hard disk drive with DMA industry-standard SMD controller and Cromix drivers from Intelligent Terminals Corporation can be added to your Cromemco system today. With 80-megabytes of fixed memory and 16-megabyte removeable cartridge for back-up, Cromemco users can expand their mass storage to accomodate most any requirements.

CPMSIM[2] Softpack **$195**

This CP/M[3] simulator program by Magic Circle Software (MCS)[2] allows CROMIX and CDOS users to run virtually any program written for use under the CP/M operating system.

MCS Tape Back-up Softpack **$195**

Drivers for ¼-inch cartridge tape drives for back-up of CROMIX-formatted disk drives include an interactive program which allows back up and restoration of individual files, directories and entire file systems, using full CROMIX path names.

LYNC[4] Communications Softpack **$195**

MCS adaption of a popular and very powerful communications package. Fully compatible with the original LYNC package, which includes the ability to send and receive Text and Binary data with checksums, and a Terminal Emulation Mode. For use under CROMIX, CDOS, or CP/M on Cromemco systems.

ComputerCenters
of America

New Houston address:
2200 Southwest Freeway, Houston, Tx 77098 (713) 527-8008
2629 Stemmons Freeway, Dallas, Tx 75204 (214) 638-4477

[1]CROMIX and CDOS are trademarks of Cromemco, Inc.
[2]CPMSIM and MCS are trademarks of Magic Circle Software subsidiary of CCA
[3]CP/M is a registered trademark of Digital Research Corporation
[4]MCS is licensed by Computer-Aide for sales of LYNC

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Volume Two, Number Five

I/O News The Official Publication of The International Association of Cromemco Users is available through membership in the association. Editorial and advertising policies are designed for the enlightenment of the members in regard to new uses for, and developments of, Cromemco products and other products compatible with Cromemco systems.

COVER FEATURES

ARTICLES & FEATURES

DEPARTMENTS

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Richard Kaye
Editor and Publisher

Typography
Dynacomp, El Toro, CA

Printing
Shears Litho, Santa Ana, CA

input...

Editor:

Thank you for printing my little blurb about re-executing under CDOS (Jan/Feb 1982).

I also wanted to let you know about some interesting situations we had with version 11.05 CROMIX. In trying to get users on the TU-ART, we found that our Revision E TU-ART would not work. Page 363 of the CROMIX manual indicates that Revision E TU-ARTs should work. A call to Cromemco's Customer Service Department put me in contact with a hardware engineer named Gary. He was most helpful with some changes to the TU-ART which permit it to function under CROMIX. Other IACU members may be interested in this conversion.

First, make sure that IC34 is a 74L500. Pull IC34 from its socket and bend pin 5 so that it will stick out to the side, then re-insert it into the socket. Pin 5 should be sticking out parallel to the PC board. Now connect jumper wires on the foil side as follows:

1. Pin 12 of IC13 to pin 6 of IC10
2. Pin 13 of IC13 to pin 2 of IC13

Finally, connect a wire from pin 11 of IC13 to pin 5 (the one that's sticking out) of IC34.

For the PRI board to work without conflict with the TU-ART, remove IC14 from the board, bend pin 1 out to the side and then re-insert into the socket.

Before these conversions, our Z-2D would simply crash or we would get the "runaway program aborted" error message and nothing else would work. The above conversion took 10 minutes and CROMIX began working beautifully.

I was concerned about the complexity and suitability of CROMIX, but after a week's usage I think I'm hooked. Keep on, I/O News is getting better.

Cordially yours,
Sam Guccione, Member #00992
Delaware Technical & Community College
Dover, Delaware

Editor:

In response to your appeal in "bits & bytes, nibbles & tweaks," I would like to inform you and your readers about a statistical package I am working on. The package has been developed over the past year as part of an ongoing research effort at the University of Houston. The package is written in Cromemco FORTRAN and has the following capabilities:

- Multiple Correlation Analysis
- Multiple Linear Regression
- Polynomial Curve Fitting
- Factor Analysis
  Extraction of Arbitrary Orthogonal Factors
  Varimax or Quartimax Rotation on Orthogonal Factors
- Canonical Correlation
- Multiple Partial Correlation
- Multivariate Analysis of Variance (MANOVA)
- Discriminant Analysis
- Classification Procedure (Geisser's equal dispersions, small samples procedure)
- Multiple Covariance Analysis
- Factorial Discriminant Analysis

Currently, these programs need to be thoroughly documented. I expect to complete the work over the next few months. I would be interested in finding out just how much interest there is in this type of package. Also, what capabilities should be added? Which capabilities aren't needed? Any help would be greatly appreciated.

While I'm on the subject of scientific software, I wonder if anyone is interested in a mathematical programming package. I have a program that is capable of solving medium scale linear programming problems (250 variables, 150 constraints). The program uses a revised simplex algorithm with product form of the inverse. Is there any interest?

Thanks for any help you might be able to provide me. I can be reached at the address below.

Sincerely,
F. Robert Jacobs, Ph.D., Member #01442
7602 Pin Oak Drive
Humble, TX 77338
(713) 446-1643

Editor:

I contacted you a few months ago about the forthcoming availability of IFDAS, An Interactive Forecasting and Data Analysis System. It is now available for sale. Information regarding its purchase may be obtained from me at the address below.

We would like to extend to you the opportunity to review our package. We feel that IFDAS will be highly useful to many Cromemco users, and will compare very favorably with any similar product available on any micro.

A comparative article on our product, would provide your membership with valuable information about IFDAS. Such an article would provide your members with a fair and complete view of the currently available software in this area of interest.

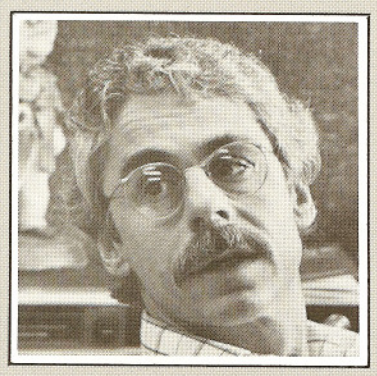
We will be happy to send you a version of the package. Our only requirement is that the copy be used strictly for review.

Please let me know when we can arrange a review.

Sincerely,
Wayne T. Watson, Member #01175
The Software Hill
1857 Apple Tree Lane
Mountain View, CA 94040
(415) 969-4233

(Editor's note: Any member qualified to review IFDAS, and interested in preparing a report should contact I/O News, or Wayne Watson.)

output



Survey Reflections

As promised, we are making every attempt to respond to your survey comments. This issue reflects one of the first areas of strong interest with the introduction of **32K Classroom**, edited by Michael Turnage. Turnage has a versatile background as a programmer in several languages and with several brands of hardware. He is also a member of Cromemcohorts, the eminently successful Los Angeles area users' group, where he conducted a review course in 32K Structured BASIC for fellow Crohorts.

Whereas Mike will be preparing an organized series that teaches readers, guest input will be welcomed. Perhaps you know of a bug or a better way of accomplishing a task. The **32K Classroom** will be the proper forum for discussing such items. Merely mail your ideas to 32K Classroom, c/o I/O News.

Another new department started in response to your comments is **Soft Tips**, edited by Norman Vadnais, a programmer and director of Cromemco sales with Applied Research, Inc., a Los Angeles area computer consulting firm. **Soft Tips** will deal with a broad range of software items and, again, members are encouraged to submit their comments and ideas. Send your input to Soft Tips, c/o I/O News.

CDOS & CROMIX Drivers

Again, two of the most asked for items on the surveys were the drivers for both CDOS and CROMIX. CDOS drivers are available now in the Assembly package (and manual), while CROMIX drivers will be released soon. At present, CROMIX is undergoing some long range revision and release of drivers will have to await the success of this project.

SUDS Reminder

The preceding paragraph reminds me of an item that continues to come to our attention. Have you subscribed to SUDS (Cromemco's Software UpDate Service) for your operating system—at least your operating system? We get so many calls and letters from members who want certain enhancements in Cromemco software and then discover that such enhancements already exist. Except not in their version.

Please do yourselves a favor. Subscribe to SUDS for your operating system—whether CDOS or CROMIX—and any other Cromemco software on which you rely on a regular basis. We constantly receive reports from members that SUDS is the cheapest, most effective way to get the maximum out of their systems.

FORTH in Your Future?

Probably not. At least not from Cromemco. Several survey forms indicated an interest in FORTH, but this is more than just a language. It is both an operating system and a language, and while it is very popular with those who use it, it would seem redundant for Cromemco to supplant two very well accepted operating systems with a third. For those who are still interested in FORTH, we suggest you contact the FORTH Interest Group at P.O. Box 1105, San Carlos, CA 94070.

Continuations Minimized

Another item mentioned often on survey responses was the irksome practice of having to skip several pages to continue reading an article. Okay. We're trying. We will keep articles in page order AS MUCH AS WE POSSIBLY CAN. This is not an ironclad guarantee that you won't have to occasionally skip a few pages to follow a story, but for the most part we can keep this as simple as turning the page.

New Products from Cromemco

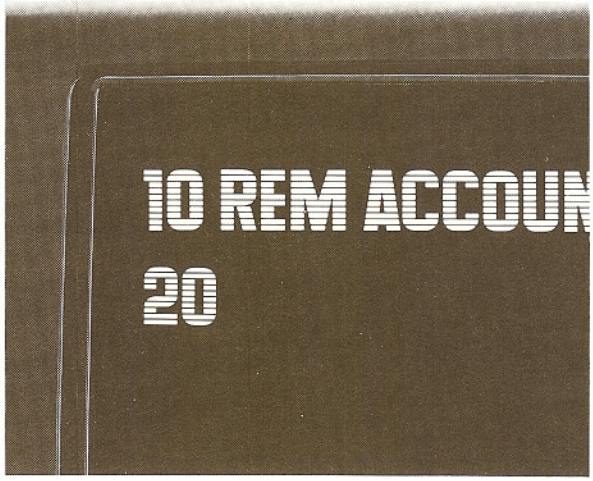
This has been a banner year for Cromemco in terms of new products introduced—and about to be introduced. Watch for such things as 16-bit software (both operating systems and languages), larger memory boards, smaller terminals, lower prices on many products—especially memory-related products. We are always hesitant to give specifics prior to actual release as we do not want to mislead, or be guilty of holding out false hopes in the event a product is delayed, but watch I/O News for announcements as new items are released.

Local Users' Groups

Once again, many survey respondees asked for a listing of all local Cromemco users' groups. With this issue, we have included such a listing of all those groups of which we are aware. (See Table of Contents.) If you know of others that should be on the list, or if you want to start a group in your particular area, please contact us. We will do everything possible to help you publicize a local group.

Richard Kaye
Editor

BOY, IS THIS COSTING YOU.



It's really quite basic: time is money.

And BASIC takes a lot more time and costs a lot more money than it should every time you write a new business software package.

Especially when you could speed things up with dBASE II.

dBASE II is a complete applications development package.

Users tell us they've cut the amount of code they write by up to 80% with dBASE II.

Because dBASE II is the high performance relational database management system for micros.

Database and file handling operations are done automatically, so you don't get involved with sets, lists, pointers, or even opening and closing of files.

Instead, you write your code in concepts.

And solve your customers' problems faster and for a lot less than with BASIC (or FORTRAN, COBOL or PL/I).

dBASE II uses English-like commands.

dBASE II uses a structured language to put you in full control of your data handling operations.

It has screen handling facilities for setting up input and output forms.

It has a built-in query facility, including multi-key and sub-field searches, so you can DISPLAY some or all of the data for any conditions you want to apply.

You can UPDATE, MODIFY and REPLACE entire databases or individual characters.

CREATE new databases in minutes, or JOIN databases that already exist.

APPEND new data almost instantly, whether the file has 10 records or tens of thousands.

SORT the data on as many keys as you want. Or INDEX it instead, then FIND whatever you're looking for in seconds, even using floppies.

Organize months worth of data in minutes with the built-in REPORT. Or control every row and column on your CRT and your printer, to format input and output exactly the way you want it.

You can do automatic calculations on fields, records and entire databases with a few keystrokes, with accuracy to 10 places.

Change your data or your entire database structure without re-entering all your data.

And after you're finished, you can protect all that elegant code with our run-time compiler.

Expand your clientbase with dBASE II.

With dBASE II, you'll write programs a lot faster and a lot more efficiently. You'll be able to write more programs for more clients. Even take on the smaller jobs that were out of the economic question before. Those nice little foot-in-the-database assignments that grow into bigger and better bottom lines.

Your competitors know of this offer.

The price of dBASE II is $700 but you can try it free for 30 days.

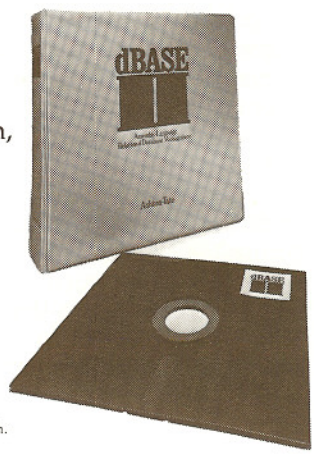
Call for our Dealer Plan and OEM run-time package prices, then take us up on our money-back guarantee. Send us your check and we'll send you a copy of dBASE II that you can exercise on your CP/M® system any way you want for 30 days.

Then send dBASE II back and we'll return all of your money, no questions asked.

During that 30 days, you can find out exactly how much dBASE II can save you, and how much more it lets you do.

But it's only fair to warn you: business programmers don't go back to BASIC's.

Ashton-Tate, 9929 Jefferson, Culver City, CA 90230. (213) 204-5570.



Ashton-Tate

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Continued from front page

C-10 Unveiled At NCC

will be priced at $195, the model CST ergonomic stand at $195, the 390 Kb model CFD floppy disk drive at $595, and the model CLQ letter-quality printer at $895. "The complete system packages are a better deal, however, because we are including over $1,000 worth of software with those for free," Garland observes.

The offering of an 80-character wide graphics display puts the C-10 in direct competition with personal computer systems costing more than twice as much as the Super Pak. Other low-cost computer systems have offered 40-column, 52-column, and 64-column displays, but Garland contends that an 80-column display handles both word processing and spread-sheet applications better. "Just look at the higher-priced office automation systems; they all have 80-column displays," he observes. "Nobody wants to flip between two horizontal windows all the time in order to view a single line of text, or to be constantly reformatting their text from a display width to a printing width."

The use of double-sided, double-density 5¼-inch floppy disk drives is just as important in word processing applications as graphics. The use of this technology gives the C-10 drives 390 kilobytes of storage per drive, or approximately twice the total storage capacity of other low-cost systems. This additional on-line storage has proven useful with word processing programs, because they generally require disk storage about three times as large as a text file. The extra space is needed to keep a backup copy and editing space as well as the working text. The C-10 Super Pak system includes one such drive, and a second 390 Kb drive can be added for $595, thus bringing the total disk capacity to 780 kilobytes. The second disk drive attaches directly to the first drive in a daisy-chain configuration. (The 8-bit parallel port can also be used as a direct memory access (DMA) port in future upgrades to a hard disk system).

The C-10 will also be offered in a deluxe word processing package which will be priced at $2875 and include all the components of the Super Pak along with an ergonomic stand and a letter-quality daisy wheel printer. The letter-quality printer features fully-formed characters and a 120 word per minute print speed. "This represents a jump in the performance-to-price ratio for word processing systems. We now offer a complete system with printer and software for just about the price that people have been paying for a letter-quality printer alone," notes Garland.

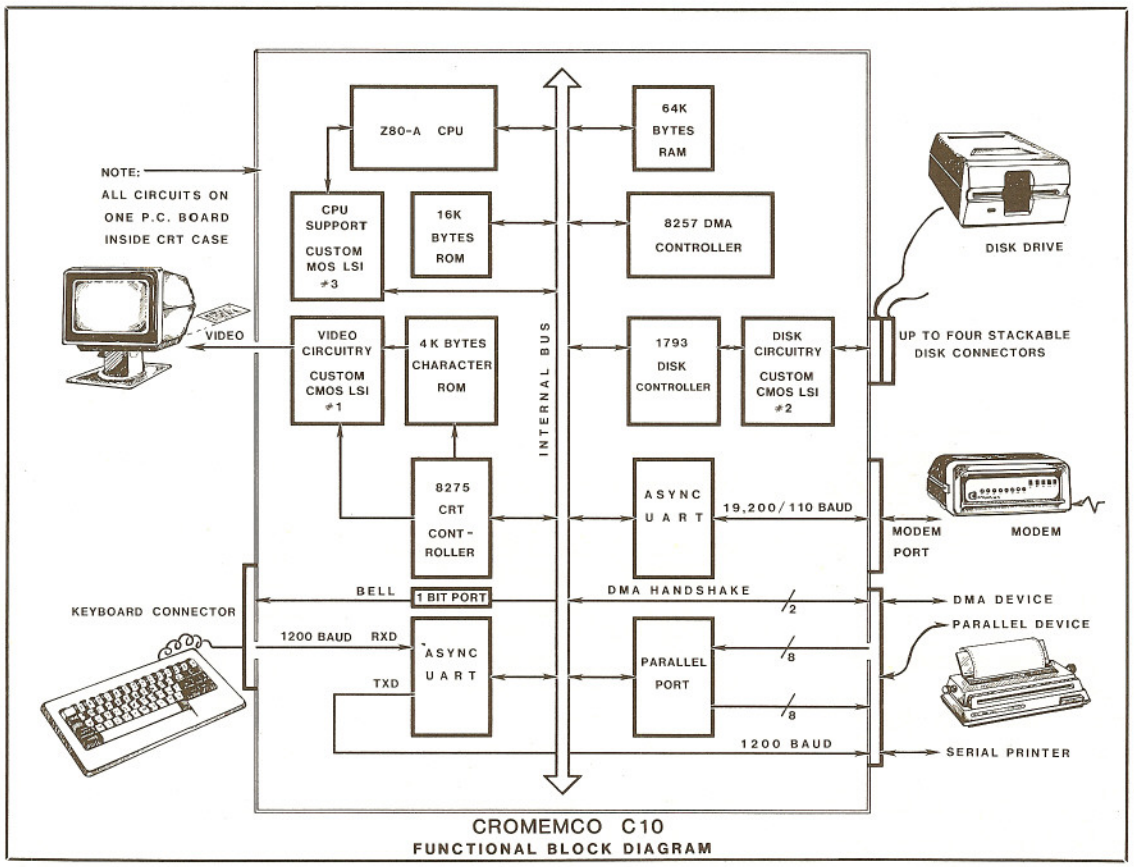
To achieve the price/performance breakthrough represented by the C-10, Cromemco became the first manufacturer to use custom large scale integrated circuits (LSI) to bring a personal computer into mass production. "We have gone with custom CMOS technology to create LSI chips for CPU support, for the video controller, and for the disk controller in the C-10" notes Garland. "This reduces the parts count on the C-10 to about 45 IC's, where it would have been about 105 to do the same design without the custom chips."

While forming a new low end to the Cromemco line, the C-10 is also upwardly software compatible with other Cromemco computers, including the System One, System Two and System Three series. One can literally take a diskette containing software out of the personal computer's disk drive and plug it into a 5¼" floppy drive in a larger Cromemco computer. The reason is that the drives are the same, and Cromemco's CDOS operating system is the same. CDOS is Cromemco's enhancement of the CP/M operating system, and while it allows CP/M-based programs to run it also lets the user take advantage of enhanced features. All programs that can run under the CP/M or CDOS operating systems can also be run under CROMIX, Cromemco's proprietary version of the UNIX multi-user, multi-tasking operating system. If a piece of software is written in Cromemco's Structured BASIC language, that program created on the C-10 can even run on Cromemco's 16/32-bit Motorola 68000 microprocessor-based CPU board, the DPU. Since a user's software development costs are likely to be much greater than hardware costs, this assurance of program migration is an important feature. In addition to the Structured BASIC included with the Super Pak and deluxe word processing packages, it should be noted that a variety of high-level languages, including FORTRAN, Rational FORTRAN, and COBOL are optionally available, along with a number of utility and applications programs.

The C-10 and its peripherals come with an industry-standard 90-day warranty and service can be obtained from TRW, the largest third-party service organization in the United States.

Production runs of C-10 systems are scheduled so that all Cromemco dealers will receive at least one demo system by October, with fulfillment of customer orders commencing in January, 1983. This schedule allows for an orderly transition of Cromemco's production facilities while continuing to meet heavy demand for the existing product line. CD

C-10 Unveiled At NCC



CROMEMCO C10
FUNCTIONAL BLOCK DIAGRAM

COGO:

Continued from Front Page

COGO4.LST
COGO5.LST
COGO6.LST
COGO7.LST

The overlay structure is easily modified so as to adapt the package to the available memory space.

These modules are still continuously being updated and extended. This program provides the user with an applications-oriented language designed for civil engineering geometry problems. Each of the COGO modules contains a number of different commands. The commands can be used in solving computational problems in control surveys, highway design, bridge geometry, subdivision work, land surveying, construction layout, and many other applications.

The COGO package operates in a conversational mode, i.e., the program prompts the user to enter a command, and the appropriate parameters.

The basic data items on which the COGO commands operate are a set of POINTS. These points are either created externally (e.g. as a result of land surveying), or generated internally as a result of the application of one of the COGO commands to the existing points. As COGO commands are used to enter or calculate points on traverses, alignments, curves, etc., these points (pairs of coordinates) are stored in a common storage area which is called the coordinate base. The coordinate base may be saved at any time during execution of any of the programs, by writing it to an output file; it may then be stored away for use at a later date, or for use with another COGO program.

The COGO package uses the long floating mode (double precision) in order to maintain the best possible standards of accuracy.

Command Structure

There are a total of 49 functional commands in the COGO package.

Each command is represented by a command code number or an alphabetic mnemonic code. Either representation may be used when entering a command from the keyboard.

All commands are listed below by their numeric and mnemonic codes, and a very brief keyword description of the command.

0 HALT Terminate the program
1 RDFILE Load coordinate base from attached input file
2 ENTER Enter coordinates
3 DUMP Print coordinates
4 CLEAR Clear coordinates
5 COPY Copy coordinates
6 WRFILE Write coordinate base on attached output file
7 COMMENT Enter a line of comment information
8 CORTRAN Translate coordinates
9 ROTATE Rotate coordinates
10 SCALE Scale coordinates
11 INVAZ Inverse azimuth
12 DIST Distance between two points
13 ANGLE Angle of three punten
14 TANGENT Tangent
15 PARALL Parallel line
16 LOCAZ Locate azimuth
17 LOCLINE Locate line
18 PTINT Points intersect
19 AZINT Azimuth intersect
20 ARCARC Arc arc intersect
21 ARCLINE Arc line intersect
22 ARCAZ Arc azimuth intersect
23 AREA Area
24 AREAPL Area plus
25 AREAMI Area minus
26 AREAAAZ Area azimuths
27 SEGAREA Segment area
28 DIVLINE Divide line
29 OFFINT Offset intersect
30 TANOFF Tangent offset
31 COMPANG Complement angle
32 SUPANG Supplement angle
33 FITCURV Fit tangent curve
34 ARCDIS Locate arc distance
35 DEFCURV Define alignment
36 ALIGN Define alignment
37 CORPTS Coordinate points
38 COROFF Coordinate offset
39 STACOR Station from coordinate
40 OFFALIGN Offset alignment
41 DIVALIGN Divide line on alignment
42 SIMPSPI Simple spiral
43 SPIOFF Spiral offset
44 SPILEN Spiral length
45 CORSPI Coordinate spiral
46 LINESPI Line spiral
47 CURVSPI Curved spiral
48 FITALIGN Fit alignment

The Coordinate Base

The coordinate base is a data storage area which holds coordinate points. A coordinate point is composed of two values, a north and an east coordinate value, and is accessible through a unique point identification number. This identification number may be any integer between and including 1 and 640. Therefore, no more than 640 points (1280 values) may be in the coordinate base at one time. Points may, however, be cleared or replaced at any time.

A coordinate point can be entered into the coordinate base in one of three ways:

1. The user may enter the coordinate values directly from the keyboard using the ENTER command (code 2).

2. The coordinate values may be calculated or retrieved internally and then stored as a result of the processing of a COGO command.

3. An entire set of 640 coordinate values may be read from an attached input file using the RDFILE command (code 1). The coordinate base on the input file may have been created independently by the user (must have 1280 values), or it may be a coordinate base created during a previous run via the WRFILE command (code 8). WRFILE writes the 1280 values of the coordinate base storage area on an attached output file. (See next section on Files for further details).

At the start of a COGO session, the coordinate base storage area is always cleared. This means that, initially, all coordinate values are internally set to a fixed value. Note that if a set of coordinate values is located on an attached input file, the command RDFILE (code 1) must be used to enter these values in the coordinate base.

File Handling

Defining Files

Files are defined when the COGO program is started up.

File names are any file name accepted by Cromemco's Structured BASIC and Operating System.

Read and Write files are specified (attached) to the COGO package by entering their names from the keyboard. These file names are requested by the program at the start of execution. If no input or output file is to be used during a run of the program, then an empty file name (carriage return) must be entered.

Use of Files

Files are only used to read an al-

ready existing coordinate base from an input file, or to write and save the current coordinate base on an output file. However, if it is not desired to read a coordinate base, it is not necessary to do so, and no input file need then be specified. Similarly, if it is not desired to write the coordinate base, it is not necessary to do so, and no output file need be specified.

If an input file is used, it is usually an output file from some earlier run of the COGO program. This procedure permits continuous processing over as many different computational sessions as desired. When using files in this manner to keep a continuous record of computations, the user must always specify the last output file as the next input file.

An input file containing a coordinate base may also be created by the user himself in a variety of ways. One possible situation might be where a user wishes to copy another user's current coordinate base for his own use.

An output file may be any defined file, including the current input file. If the input and output files are the same, a backup file is created (extension .OLD) from which the original contents may be retrieved.

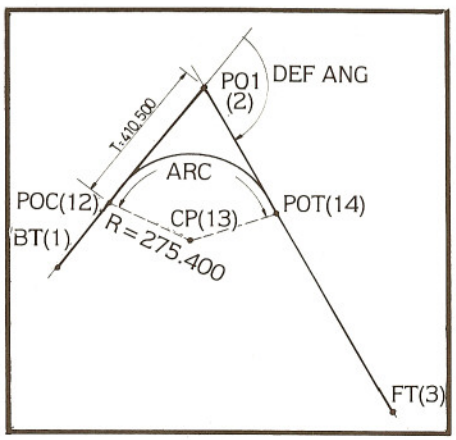
In summary, the following file features are applicable:

* Input or output files may or may not be specified, depending on how the user intends to use the programs.
* The output file may be the same as the input file (this feature eliminates the need to always have two files for one job). A backup copy of the input file is then generated.
* The coordinate base may be read from the input file as many times as desired (command RDFILE (code 1)).
* The coordinate base may be written on the output file as many times as desired (command WRFILE (code 8)).

An Example

Below is an example of the ENTER and ALIGN commands. User responses are underlined.

```
>>RUN
SPECIFY INPUT FILENAME:
SPECIFY OUTPUT FILENAME:
   DEMO1
NEW FILE: DEMO1
COMMAND? ENTER
NO OF POINTS? 4
INPUT POINT NO. NORTH COORD.
   EAST COORD?
? 1,0 – 400
? 2,500,0
? 3, – 400,500
? 4,0,1000
COMMAND? ALIGN
NO, BT, POI, FT, POC, CP, POT, R, T,
   STA, SEC? 10,1,2,3,12,13,14,0,
   410.5,120,
CURVE 10 CURVES RIGHT
RAD: 275.400 ARC: 539.716
DEFL ANG: 112 DEG 17 MIN 8.116
   SEC
POC STA: 349.812 POT STA:
   889.528 TAN: 410.500
POC: PT 12 : 179.453 NORTH -
   256.437 EAST
POT: PT 14 : 141.158 NORTH
   199.356 EAST
CEN: PT 13 : 7.413 NORTH -
   41.386 EAST
COMMAND?
```



CURVE 10

The COGO package provides the user with an interactive application-oriented language designed for civil engineering geometry problems. The commands may be applied to the computational problems involved in control surveys. Motorway design, bridge geometry, subdivision work, land surveying, construction layout, and many other areas.

The COGO package is written in Cromemco's Structured BASIC and heavily uses dynamic overlays.

About the Author

Jan M. Van Campenhout was born in Vilvoorde, Belgium, on August 9, 1949. He received the engineer's degree from the State University of Ghent in 1972, and the MSEE and Ph.D. degrees from Stanford University in 1975 and 1978, respectively.

Mr. Van Campenhout is currently with the Electronics Laboratory of the Ghent State University. His interests include digital design, microprocessor applications and statistical techniques. Mr. Van Campenhout is a member of Sigma Xi.

(Editor's note: Upon receipt of this article, we asked Lerose Lane, a civil engineer who had been researching surveying software in her capacity as a professional engineer with the Tehama County (California) Road Department. Her comments follow:

Dear Richard:

After reviewing the COGO program from Belgium, I have several questions that need to be answered. They are:

1) Is the source code furnished?
2) Does the program compute the parcel area in acres or only in square meters?
3) Can the number of coordinate pairs be resized for larger or smaller systems?
4) Can the reference point names be changed since some of the surveying terminology is different in the United States?
5) Can points be plotted on the letter quality printer or the screen?
6) Does the program have a subroutine to distribute error for traverse closures? Most programs use "Compass" or "Crandell" closure methods to distribute closure errors.

Generally, the price is very reasonable compared with other companies.

Microcomp — $500
Disco Tech — $1,500
Sierra Cybernetics — $2,000
Peach Tree — $350

All the above programs are menu driven and should operate under CDOS, or CROMIX (in the near future) with the use of Royal Data's "CPM-Emulator" and the appropriate Basic or Fortran package. Most of the available COGO packages operate under a CPM operating system.

The Belgium package is interesting because it would save hav-

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COGO:

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ing to buy extra software. The purchased 32K-Structured Basic and Fortran IV would work without additional software.
Sincerely,
Lerose Lane
Professional Engineer

We then forwarded Ms. Lane's questions to Paul Styfhals in Belgium and received the following reply:

Dear Mr. Kaye,

Thank you for your letter concerning our COGO program and related article.

In response to your questions we can say that:

1. The source code can be furnished on request (perhaps at an additional fee). The program has been written in Cromemco's Structured BASIC.

2. We propose to furnish the source code of those parts of the program necessary for customization. Alternatively, we are prepared to consider customization ourselves, at a price that can be agreed upon.

3. The number of coordinate pairs can be resized and is a function of the version of Structured BASIC used (the program doesn't use Ksamfunctions).

Obviously we can implement the parcel area in acres instead of square meters (or square feet), as it is now.

A subroutine to distribute error for traverse closures is being implemented and will be available soon.

As of now, the COGO program is being equipped with a ninth overlay enabling one to generate graphic output consisting of typed points, lines, circles, spirals and text.

Using an interactive program featuring scaling window and clipping, plots can be generated on a low-cost digiplot type plotter (manufactured by Watanabe Inc., Japan).

Hoping that these remarks answer your questions, we remain
Sincerely yours,
Paul Styfhals
Managing director

Interrupt Processing:

Continued from front page

the fact that it is usually associated with "system," rather than "application" programs, interrupt processing tends to be misunderstood or made to appear much more difficult than it needs to be.

What then, is an interrupt? In simple terms, an interrupt is a signal to the processor, typically generated by an external device. The interrupt causes the processor to stop executing the current instruction stream and branch to another sequence of instructions written to handle the cause of the interrupt. Probably the most important concept to be noted about interrupts is that the **source** of an interrupt is **hardware** (although some processors have machine instructions that simulate interrupts), but the resulting action taken because the interrupt occurred is implemented on the processor in **software**. The software that handles the cause of the interrupt, or takes an action based upon the occurrence of an interrupt (the distinction will be made later) is commonly referred to as an **interrupt service routine.**

Why do we need interrupts in a computer system? In some cases, the answer to this question may be "we don't," but in other cases (depending upon the required system environment), interrupts are very convenient or even necessary for proper system operation. To demonstrate, let's draw the analogy between an interrupt in a computer system and the bell in a telephone. Imagine that you are at home, going about your normal day-to-day activities. Your attention is on the task at hand and you are performing this task in a serial (step-by-step) fashion. Suddenly, the phone rings! Subconsciously, you remember the last step you performed on whatever it was you were doing, then answer the phone. Typically, after the phone conversation has ended, you return to what you were doing, picking up your task at the point where you left off. The ringing of the telephone in essence "interrupted" what you were doing for a short time so you could answer the call.

Now, what if we didn't have bells in our phones to let us know when a call was coming in? If you weren't expecting a phone call, then there's no problem. You would work on your chores around the house until they were completed. However, if your broker was going to call, you might not want to miss the good news. In order to see if (s)he were on the line, you would, at certain intervals in time, pick up your phone to see if anyone was there. Clumsy, and a very inefficient use of your time, but effective.

Using this analogy, you were playing the part of the processor and the telephone bell (or lack of it) was an interrupt. The processor will usually execute an instruction stream (program) until it is finished or until it is interrupted in order to perform another task. As long as there is nothing else expected to happen in the system environment, the processor will execute the current instruction stream. But if some external event is expected to occur that requires processing (an I/O operation, a certain period of elapsed time, etc.), the processor (program) must either look for an indicator that the event has occurred (i.e. picking up the phone to see if anyone is there) which is usually referred to as "polling," or continue processing on the current task until interrupted (the phone rings). After performing some work based upon the cause of the interrupt, the processor will resume working on whatever task was executing before the event that caused the interrupt occurred. In certain system environments, interrupts are not really required and therefore, are not used. These environments are typical of single-user microcomputer systems executing their programs serially (one at a time until complete). If you will, since we are not expecting a phone call, there is no need to pick up the telephone to see if anyone is there. However, as the system environment becomes more complex (multitasking/multiuser), we have to decide whether to continually pick up the phone, or "poll," for the occurrence of an expected event (what happens when we have two or more phones?), or alternatively, we can enable the inherent ability of the processor to recognize interrupts and execute service routines to handle the cause of the interrupt.

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A Tutorial

Implementation of Interrupts

There are two areas of concern that must be examined in the implementation of interrupts in a computer system, which are:

1) How the hardware system handles the occurrence of an interrupt.

2) The requirements of the software interrupt service routine written to handle the interrupt.

It is important to understand how the hardware works before we can write the software, so let's examine the workings of the hardware first.

Vectored vs Non-vectored Systems

Almost all processors (mainframes, minicomputers and micros) handle the occurrence of an interrupt in one of two ways; **vectored** or **non-vectored.** The major difference between the two lies in how the processor handles the branch (transfer of control) to an interrupt service routine, and more subtly, how it determines the source of the interrupt. Vectored systems typically use the source of an interrupt to aid in selecting the appropriate service routine to which to branch. Non-vectored systems will often branch to one common routine, which in turn determines the source of the interrupt (usually via an internal register which is set to reflect the source) and causes control to be transferred to the appropriate routine, performing "housekeeping" chores common to all routines prior to invoking an interrupt-specific set of instructions. Within these two major categories, the details of implementation become very processor or system specific.

Since we will soon be discussing the implementation of an interrupt service routine on Cromemco hardware, it is appropriate to examine the way the Z80 processor handles interrupts in detail.

Z80 Interrupts

The Z80 is typical of a processor that uses vectored interrupts. The Z80 recognizes two different types of interrupts, **maskable** and **non-maskable.** The major difference between the two lies in the fact that a non-maskable interrupt may not be disabled and a maskable interrupt can be selectively enabled or disabled. Non-maskable interrupts, because of the characteristic of always being enabled (except while processing is being performed on their behalf), are used to detect extremely critical events and do not provide the overall flexibility of maskable interrupts. We will be dealing entirely with the concept of maskable interrupts in our discussion, primarily because the non-maskable interrupt does not fit well in a general interrupt-driven system unless used exclusively to detect a critical event.

The Z80 has three different maskable interrupt modes, which depending upon the mode currently set, determine the way the processor will form a branch address based upon receipt of an interrupt signal:

1) Mode 0. This mode is used to allow the Z80 to maintain compatibility with the 8080 processor. It provides for eight different branch addresses using the RST instruction for transfer of control. This mode is limited in the fact that the interrupt vectors must always reside in specific locations in memory and the location of the vectors cannot be changed.

2) Mode 1. This mode can be used to implement a Central Interrupt Control (CIC) scheme typical of non-vectored systems. Control is always transferred to the same memory location no matter what the cause of the interrupt may have been. It is then the responsibility of a single routine to determine the source of the interrupt through some means, and cause control to be transferred to the appropriate interrupt service routine. Mode 1 in essence defeats the operation of a vectored system, but does provide a simple mechanism to implement CIC.

3) Mode 2. This mode is often referred to as "Z80 mode" and is the most flexible of the three in terms of vectored interrupts. The following detailed discussion describes how the Z80 works when in Mode 2, and this is the mode we will use when implementing the sample interrupt service routine presented later in the tutorial.

To understand how the Z80 forms a branch address when in Mode 2, we should step through the receipt of an interrupt to the actual branch and execution of the first instruction in the interrupt service routine.

At the end of each instruction cycle (except for some of the block data instructions), the Z80 checks the status of the interrupt system. If interrupts are enabled (through the use of the EI instruction — the Z80 disables them on RESET) and an interrupt is pending (the INT input to the Z80 is held low), the following sequence of steps take place:

1) The interrupt system is disabled (effectively the same as executing the DI instruction). This is done in order to prohibit another interrupt occurring in the system from being recognized until an EI instruction is executed.

2) The processor executes an Interrupt Acknowledge cycle. This effectively is a handshaking arrangement with devices in the system capable of generating interrupts, allowing them to identify themselves to the processor at the proper time as the source of the interrupt.

3) The interrupting device, upon detection of the Interrupt Acknowledge cycle, places an eight bit quantity on the data bus inputs (D0-D7) of the Z80.

4) The contents of the Program Counter (PC, which contains the address of the next instruction to be executed) in the processor is stored in RAM at the location pointed to by the Stack Pointer (SP) and SP is decremented by 2 (equivalent to PUSH rp).

5) A 16 bit memory address is formed by using the contents of the Interrupt (I) register (discussed below) as the eight most significant bits, and the eight bit quantity input on D0-D7 during the Interrupt Acknowledge cycle as the eight least significant bits.

6) Two bytes, starting at the address formed in 5), are fetched from memory. This 16 bit quantity is treated as the address (vector) of the start of an interrupt service routine.

7) The 16 bit quantity fetched in 6) is loaded into the PC and a normal instruction fetch is performed. The instruction fetched will be the first instruction in the interrupt service routine. The service routine will control the system until it is finished or interrupts are enabled and the routine is interrupted.

Interrupt Vectors

If we view the 64K byte address space of the Z80 as consisting of 256

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Interrupt Processing:

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"pages," where each page contains 256 bytes, the I register effectively points to one of these 256 pages in which we can place the starting address (or vector) of the interrupt service routine. The eight bits input from the interrupting device give the displacement into the page selected by the I register, completing the address of the space where the vector can be found. It is important to make the distinction between the **address** (vector) of the service routine and the **service routine itself**, and not get the location of the two confused.

This method of computing branch addresses to service routines allows us to place the vectors anywhere in the address space of the Z80 that is convenient for the application at hand. The only other information that needs to be known to complete the location of the vector is the eight bit quantity generated by the interrupting device. This information is usually readily available in manuals describing the operation of the particular device being used.

Interrupt Service Routines

As was mentioned earlier, the name given to a sequence of instructions invoked upon receipt of an interrupt is called an Interrupt Service Routine. The primary function of this routine is to take some action based upon the occurrence of an interrupt (input/output a character to/from a device, perform timer-related functions, etc.).

In addition to the work dictated by the event causing the interrupt, certain steps must be taken to ensure system integrity by saving the operating environment at the time of the interrupt. This usually entails the saving of any registers used by the routine prior to performing any processing, and restoring them prior to exiting the routine. (The PC is typically an exception. Most systems will store the PC in a predetermined location or make it available to the programmer for storage as a function of the interrupt.) Additionally, if the interrupt service routine is to handle many devices of the same type, it must be written to be reentrant, or serious problems will occur. Interrupt routines must be totally invisible to high-level users of the system, and care must be taken not to modify or destroy the contents of registers or storage locations used by system or user software.

Interrupt service routines are generally no more difficult to write than any other program, once the problem has been defined and specified. However, because the interrupt service routine does fall under the category of system software, it must exist in harmony with other operating system software. This fact probably leads to more frustration than any other when trying to generate user-written interupt routines in certain types of systems.

In terms of adding interrupt service routines to an already existing operating system, we find that operating systems can be grouped into four broad categories:

1) Those that do not use interrupts and are well documented as to their usage of system resources.

2) Those that do not use interrupts, but have no accompanying documentation that explains system resource usage (use it but don't mess with it).

3) Those that do use interrupts and provide a mechanism (and documentation) to allow the addition of user-supplied interrupt service routines.

4) Those that do use interrupts but were not designed (or have not been documented well enough) to have user-supplied interrupt service routines added.

Obviously, the types of operating systems that are the easiest to work with fall under categories 1 and 3. Experience has shown, however, that these types of operating systems are the exception, not the rule. If no documentation comes with a system to aid in the addition of interrupt service routines (especially if the system already uses interrupts), it is unlikely that even a request to the vendor will get the proper information (many times, this information is considered proprietary, or is in a form that is not suitable for distribution). Without clear and proper documentation, there arise a multitude of unknowns that can affect proper system operation when trying to add interrupt service routines. This can lead to frustration, unreliable system operation, and system failures during normal use. Therefore, it is not recommended that interrupt service routines be added to operating system environments of which little or nothing is known.

Interrupt Service Routines Under CDOS

CDOS falls somewhere between categories 1 and 2 as far as operating systems go. Although not enough documentation comes with the system (CDOS Instruction Manual) to easily add interrupt service routines to CDOS itself, there is enough information to patch routines into the system environment and have them appear to be part of the system after it has been initialized (for example, the 3355A printer driver resides in this patch area). In reality, this concept is more flexible in terms of changing the interrupt service routine during development (CDOSGEN does not have to be performed each time a change is made, as is necessary when changing an I/O driver), and requires only a few additional lines of code to install in the area below CDOS in memory. The major disadvantage to this method is that the user must initiate the service routine each time the system is booted from disk. However, if the routine is frequently used, the STARTUP.CMD batch procedure file can be used for initialization, which eliminates most of the inconvenience.

The Problem

At CSU, Chico, we have a Cromemco Z2H Graphics System which is used primarily for computer graphics classes and as a Computer-Assisted Lecture (CAL) tool in our mediated classroom (an article on the use of CAL using Cromemco systems is forthcoming). In addition to the standard Z2HGS complement of hardware, we also have two joystick consoles attached to a Cromemco D+7AI/O card for use as input devices to the system.

In order to keep the user interface to the joysticks as simple as possible (not all users of the system are of the advanced type), we needed a routine that could periodically sample the joystick and button inputs on the D+7AI/O card and update a set of memory locations associated with each input. High level calls could then be made by users to a separate routine that would return as argu-

Continued on next page

ments the values requested (e.g. CALL JSTICK(BUTTON,X,Y)). More sophisticated users can access the memory locations directly or perform their own I/O, but most feel a single routine is the easiest and most flexible method in this environment.

Another (and very real) critierion of the problem was that we couldn't buy any additional hardware (such as a real-time clock card) to help implement this scheme. The problem had to be solved with what hardware existed and with minimal modification of the system, if possible.

The problem then was to locate a source of timer-related interrupts in the system, and use the interrupt to activate a service routine that would sample the input ports on the D+7AI/O card, then store the values input into selected memory locations. (It should be noted that the timer interrupt could also be used to input values from any A/D device, or to implement a timer or non-event driven function within the system.)

After a brief investigation, we found two major sources of timer-related interrupts that already existed in the Z2H system and could be used for our application:

1) A 512 millisecond real-time clock that could be enabled on the 16FDC (Floppy Disk Controller) card with a minor modification to the card itself.

2) 15 countdown (interval) timers (five on the 16FDC card and 10 on the TUART card) that are associated with the TMS5500 UARTS (Universal Asynchronous Receiver/Transmitter) used on these cards.

We ultimately selected one of the five timers associated with the TMS5500 on the 16FDC card for three reasons:

1) We didn't want to enable the 512 millisecond clock because it required a slight modification of the card, and we wanted a shorter time interval between interrupts than the 1/2 second this clock would provide. Additionally, we didn't really need the accuracy this clock source provided over the interval timers.

2) The use of the TMS5500 on the 16FDC card would ensure the I/O port assignments would remain the same (fixed assignments due to use by CDOS). The port assignments on the TUART can be changed via switches and a port address change could cause the routine to malfunction.

3) We had the ability to select one of 255 time intervals available on the TMS5500 (in essence, a "programmable" timer). If we needed a longer period between interrupts than the maximum available, we could always cascade additional timers.

We have experimented with several versions of this interrupt service routine (shorter time intervals, averaging joystick values over several samples to eliminate jitter, etc.). We would like to present a "skeleton" routine for discussion to make it easier for others to implement their own processing routines, by replacing the simple one we included which samples the joystick ports and updates memory locations.

Before discussing the interrupt service routine specifically, we should briefly discuss the characteristics of the TMS5500 and how it works on the 16FDC under CDOS (the reader is directed to the 16FDC Floppy Disk Controller Instruction Manual by Cromemco for more detail). It should also be noted that the interval timers on the TUART cards are the same, except the port addresses for the timers will be different.

The TMS5500 UART used on the 16FDC card handles the parallel-to-serial and serial-to-parallel conversion for the system console RS232-C port. In addition, it contains five interval timers and several registers used to control the operation of the device. Several interrupts are available from this device for timers and data receive/send.

According to the 16FDC manual, to enable the TMS5500 to respond to the Interrupt Acknowledge cycle generated upon receipt of an interrupt by the Z80, D3 of the Command Register (output port 02) must be set. However, this register also contains the High Baud (HBD) bit, D4, which appears to be set by RDOS when powering up or resetting the system. We were rather stumped by this, for if HBD was set due to the console running at 19.2K bps, we could effectively mess up the baud rate for the TMS5500 unless we also did speed sense (there is no way to read the contents of the Command Register to see if HBD is set). Through experimentation, we observed that RDOS apparently enables the 16FDC for interrupts at reset (and seems to mask out all interrupts), because all that is necessary to get the interrupts through to the processor is to set the interrupt mask (output port 03) to its proper pattern to allow the corresponding timer interrupt through. We mention this in passing mainly to inform those readers who may want to implement this routine on a TUART card, rather than a 16FDC, to make sure they add the code to set the Command Register to its proper bit pattern to allow the card to respond to the Interrupt Acknowledge cycle, or the routine will not work.

The remainder of the timer setup requires that the interrupt mask (output port 03) be set to allow the timer interrupt (please note that we used Timer 3 in this example) to pass from the TMS5500 to the priority encoder on the 16FDC and set the desired value into the timer register. The value placed into the timer register is decremented by one every 64 microseconds and when the value reaches zero, an interrupt is generated.

The Program

The program shown in the accompanying listing is composed of two sections; one that relocates and initializes the routine for operation and the interrupt service routine itself. If the reader wishes to modify the program for other applications, the following equates in the program may be of interest:

* PROGLN (in the initialization section) is used as the number of bytes to move when relocating the interrupt service routine to an area just below CDOS. It is currently set to 23H (35 decimal) as that is the size of the service routine. Please observe the interrupt vector used for Timer 3 must reside at XXDFH and XXEOH (XX is the page number). If a larger service routine is implemented, these two locations must be skipped over within the service routine. The vector was placed on the same page of memory as the service routine in order to conserve memory space.
* TIMVAL (in the service routine) is

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the value to be placed in the timer register. The current value of 255 will produce an interrupt every 16.32 milliseconds with a resolution of 64 microseconds. If more frequent interrupts are desired, this value can be decreased.

The program starts out by putting the Z80 in interrupt mode 2 (Z80 mode) and loading the I register with the proper page address. The page address is derived by loading the system call jump address located in memory addresses six and seven, and decrementing the high order byte by one (since CDOS always starts on a 256 byte boundary (page), this will let us use the page immediately below CDOS as our patch area and the page on which the interrupt vector may be found).

The next step in initializing the routine is to relocate it to the page of memory immediately below CDOS by using the LDIR instruction. The routine is relocated starting at XX10H to leave the CDOS system call 97H (moves the bottom of CDOS in memory) room to place a set of jumps (9 bytes) pointing to the old bottom of CDOS in RAM (see CDOS Instruction Manual). An additional 6 bytes are set aside for storage of the joystick data (although only 5 are used at this time).

Next, the interrupt vector that points to the start of the service routine is loaded into XXDFH and XXEOH. The same page number (XX) is used as when relocating the routine, and the value 10H is used as the least significant bits of the vector, as this is where we moved the routine in the previous step. Again, it is important to note that if the service routine is enlarged to extend past XXDFH, the vector must be preserved in order for the routine to work. If a jump is not made around XXDFH and XXEOH, the vector will be stored over the top of whatever was previously in those memory locations. The vector is located at XXDFH and XXEOH because the eight bit quantity placed on the data bus during the Interrupt Acknowledge cycle for Timer 3 is a DFH. The vector resides on the same page of memory as does the service routine for one reason — to save memory. Normally, in an environment that has multiple sources of interrupts to be serviced, all interrupt vectors will reside on the same page and the service routines will reside elsewhere.

Using the CDOS system call 97H, we reset the bottom of CDOS below our service routine, effectively patching it into the system until the next boot from disk. The stack pointer (SP) is then set to just below the new bottom of CDOS to avoid destroying any memory locations via stack manipulations.

We now set the interrupt mask on the TMS5500 to allow the Timer 3 interrupt to pass through to the priority encoder onboard the 16FDC, and enable the Z80 for interrupts via the EI instruction.

The last action needed prior to terminating the initialization portion of the program is to load Timer 3 with a countdown value to start the occurrence of interrupts. The program is terminated with the message "Timer Interrupt Enabled" sent to the console for operator verification.

When Timer 3 counts down to zero after the 16.32 millisecond interval, an interrupt is generated and control is passed to the interrupt service routine as previously discussed. This particular implementation merely polls 5 ports associated with the buttons on one joystick console and the X and Y data values for the two joystick consoles. These values are stored in memory just prior to the start of the interrupt service routine itself (addresses XXOAH — XXOEH), making them fairly safe, and accessible using the I register for the most significant (page) bits. This code can be replaced and the routine made to perform a variety of tasks based upon the periodic interrupt generated by the timer.

When the service routine is entered, the AF and HL register pairs are saved on the stack, as these registers are used by the routine and we don't want to destroy them (at a minimum on the Z80, the AF pair should be saved and restored to maintain the integrity of the flag register). After the work has been completed, the timer is reinitialized, and the HL and AF pairs are restored off the stack. Just before exiting the routine (via RET or RETI), the interrupt system must be re-enabled as the Z80 disables it after detecting an interrupt has occurred.

Other Common Uses of Interrupts

There are two major classes of applications for the use of interrupts in a computer system; event-related and timer-related. Our discussion has dealt mainly with a timer-related interrupt used to invoke a polling routine, rather than an event-related scheme that could have been used if interrupts were generated by the D+7Ai/O card. Other applications for timer-related interrupts include maintaining a time-of-day clock via software and real-time clock interrupts used to activate dispatching software in multitasking/multiuser environments. All of these functions are based upon the passing of a certain period of time, rather than the occurrence of a specific event.

In event-related interrupt systems, the interrupt is used to signal the occurrence or completion of some specific activity within the system environment. Most of these interrupts are generated via the input/output hardware, such as the arrival of a character on a serial or parallel interface, the completion of a device handling the receipt of a character, the end of a block move of data via Direct Memory Access (DMA), or the abnormal termination of an I/O operation because of some error condition. Some computer systems also react to interrupts generated by an internal condition such as arithmetic errors in the ALU, illegal instruction traps to catch the attempted execution of a binary quantity that is not a legal instruction, privileged instruction traps that prohibit the execution of certain instructions when the processor is not in the privileged state, and abnormal conditions detected by memory controller hardware such as parity errors or protection violations.

Regardless of the cause of an interrupt, the primary function is the same; to allow the processor to execute a task-specific set of instructions and not "worry" about constantly "looking" for the occurrence of these non task-related events. This in turn simplifies the design and implementation of software systems on the machine, and significantly decreases the amount of overhead required in system and user software to ensure the proper

Continued on next page

Continued from page 16

operation of the machine in its environment.

Summary

Interrupt processing, although common in most computer systems, is not widely understood nor used outside the realm of systems programming applications. Through the use of interrupts, complex software polling logic can be eliminated in systems that require the monitoring of multiple concurrent events, providing a higher degree of system reliability and maintainability. In systems that do not use interrupts (such as CDOS), interrupts can be implemented by users to aid in streamlining their applications if the mechanism of interrupt processing is understood.

About the Author

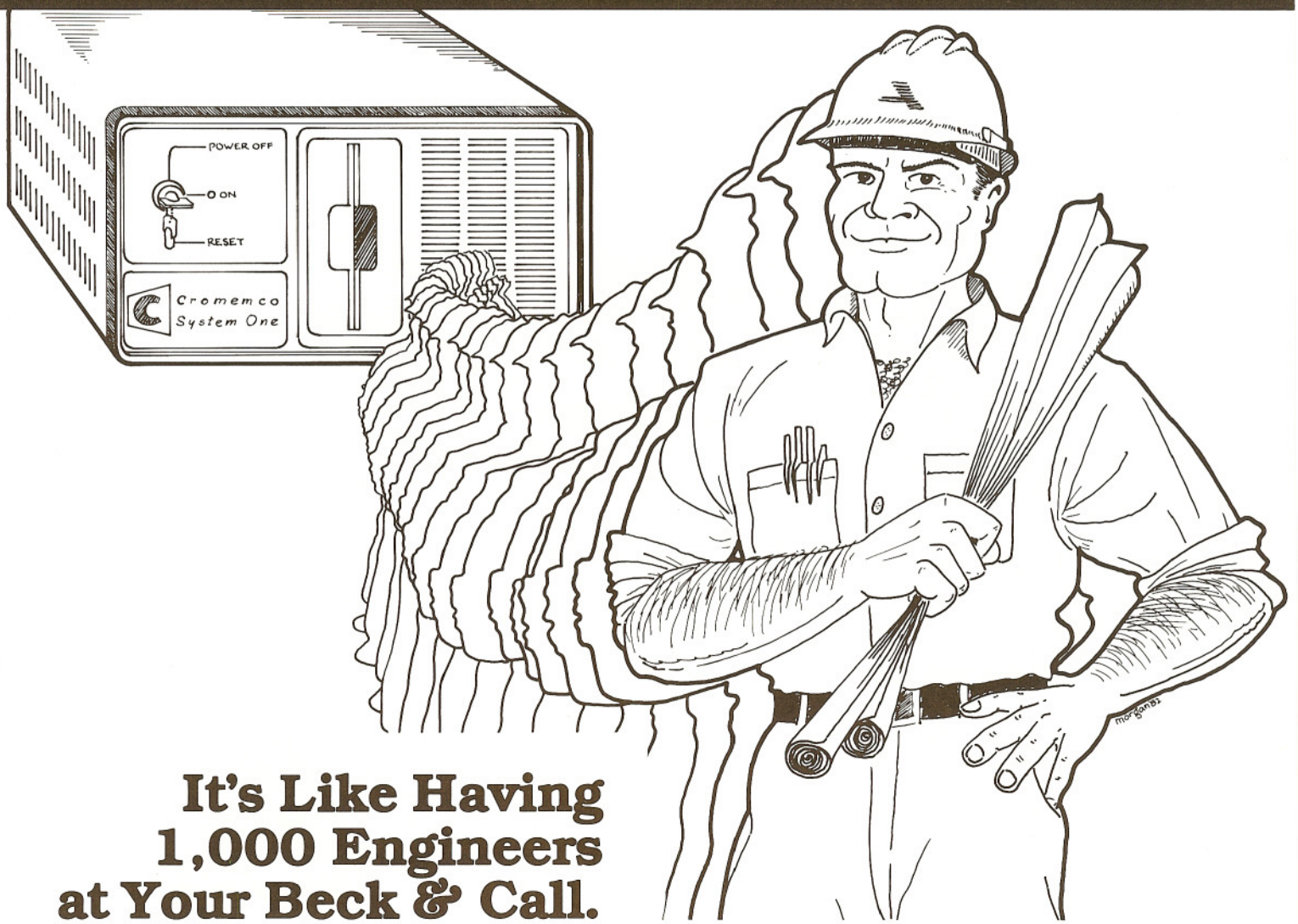
Doug McBride is a lecturer at California State University, Chico. He teaches in the areas of computer languages, machine organization, systems architecture and systems programming. He also acts as the coordinator of the mini/micro computer laboratory which contains many different types of computer systems including Cromemco. He also acts as the System Manager for the department's HP300 Series III minicomputer system.

Doug is a partner in the firm of Lane, McBride and McBride, Computer Systems Consultants (LM²). LM² specializes in general systems consulting in the mini and micro computer areas, and in a variety of applications such as environmental monitoring, data communications/networking, and short and long-term planning for a wide variety of private and public organizations. LM² currently uses a Cromemco System Three and a Cromemco System One for daily business activities.

Doug holds B.S. and M.S. degrees in computer science with degree minors in business and accounting. He is a member of the IEEE and IEEE Computer Society, as well as several special interest groups associated with IEEE, and belongs to Upsilon Pi Epsilon, the national Computer Science Honor Society.

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                                                                     ;
;       This program is a combined initialization and interrupt      ;
;       service routine to generate and react to a periodic          ;
;       interrupt source. The source of the interrupt is Timer       ;
;       3 associated with the TMS5500 UART found on the Cromemco     ;
;       16FDC card. The timer is set to its maximum value of 255     ;
;       which will generate interrupts at 16.32 millisecond inter-   ;
;       vals. Upon receipt of the interrupt, I/O ports 18H - 1CH     ;
;       (which are associated with a Cromemco D+7AI/O card and to    ;
;       which are attached two Cromemco joystick consoles) are       ;
;       polled and the received data are stored in memory at        ;
;       XX0AH - XX0EH respectively. The value of XX may be found     ;
;       in the I register which is set to point to the page that     ;
;       contains the interrupt service routine and the interrupt     ;
;       vector.                                                       ;
;                                                                     ;
;       The interrupt service routine is relocated to the page of    ;
;       memory just below CDOS and the bottom of CDOS is changed     ;
;       via system call 97H to reflect the patch. The code starts    ;
;       at XX10H with XX00H - XX0FH reserved for CDOS and joystick   ;
;       data. The interrupt vector will be located at XXDFH-XXE0H    ;
;       and will contain XX10H.                                       ;
;                                                                     ;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;
        org     200H            ; start at 200H so we know where we are
;
;       ******* INITIALIZATION SECTION EQUATES *******
;
progln: equ     23H             ; length of service routine
intmsk: equ     03H             ; port address of interrupt mask reg.
inten:  equ     08H             ; mask to allow Timer 3 through
intst:  equ     02A0H           ; address of where routine can be found
intadd: equ     0010H           ; LSB's of start of service routine
intvec: equ     00DFH           ; LSB's of interrupt vector
cdos:   equ     05H             ; CDOS system call vector
wboot:  equ     00H             ; warm boot CDOS call
conmes: equ     09H             ; print buffered line call
newbot: equ     97H             ; new-bottom-of-CDOS call
oldbot: equ     06H             ; address of old bottom of CDOS
;
;       ******* INITIALIZATION CODE *******
;
;       Set interrupt mode and get page address
;
start:  im      2               ; set interrupt mode to 2
        ld      de,(oldbot)     ; get current address of CDOS bottom
        dec     d               ; decrement MSB for new page address
        ld      a,d             ; set up A reg
        ld      i,a             ;  to move to I reg
;
;       Move interrupt service routine to page below CDOS
;
        ld      hl,intst        ; address of where routine is now
        ld      e,intadd        ; LSB of where to move routine
                                ;  D reg already has page address
        ld      bc,progln       ; length of service routine
        ldir                    ; move BC bytes from (HL) to (DE)
;
;       Store the interrupt service routine vector in XXDFH
;
        ld      h,d             ; put page address of vector in H
        ld      l,intvec        ; put displacement in L
        ld      (hl),intadd     ; store LSB's of vector
        inc     hl              ; increment memory address
        ld      (hl),d          ; store service routine page address
;
;       Reset bottom of CDOS to new page address
;
        ld      e,d             ; page address must be in E
        ld      c,newbot        ; system call number
        call    cdos            ; call CDOS to do it for us
;
;       Reset Stack Pointer (SP) to point below new bottom of CDOS
;
        ld      sp,(oldbot)     ; get address of new CDOS
        dec     sp              ; set to top of user area
;
;       Enable Timer 3 interrupt mask and enable interrupts
;
        ld      a,inten         ; mask for interrupt mask reg
        out     (intmsk),a      ; output to 16FDC
        ei                      ; enable Z80 for interrupts
;
;       Start timer on a countdown
;
        ld      a,timval        ; load timer countdown value
        out     (timout),a      ; timer register on TMS5500
;
;       Return to CDOS with message to operator
;
        ld      de,endmes       ; address of message
        ld      c,conmes        ; CDOS parm to print buffered line
        call    cdos            ; print operator message
        ld      c,wboot         ; warm boot back to CDOS call
        call    cdos            ;  to terminate initialization section
;
;
endmes: db      ' ** Timer Interrupts Enabled ** $'
;
;
        org     02A0H           ; so we know where the service routine is
;
;
;       ******* INTERRUPT SERVICE ROUTINE EQUATES *******
;
timval: equ     255             ; value to be sent to timer
timout: equ     07H             ; port address of Timer 3 on 16FDC
;
;       ******* JOYSTICK EQUATES *******
;
button: equ     18H             ; button port address
x1:     equ     19H             ; X value on console 1
y1:     equ     1AH             ; Y value on console 1
x2:     equ     1BH             ; X value on console 2
y2:     equ     1CH             ; Y value on console 2
data:   equ     0AH             ; LSB of data storage in memory
;
;       ******* INTERRUPT SERVICE ROUTINE CODE *******
;
;       Save registers before processing
;
        push    af              ; save AF pair on stack
        push    hl              ; save HL pair on stack
;
;       Poll Joystick ports and store data in memory
;
        ld      l,data          ; load L with LSB of data address
        ld      a,i             ; get I reg into A reg so
        ld      h,a             ;  H reg can be loaded with MSB of data
        in      a,(button)      ; get console button value
        ld      (hl),a          ; store in memory
        inc     l               ; increment to next data address
        in      a,(x1)          ; get X value from console 1
        ld      (hl),a          ; store in memory
        inc     l               ; increment to next data address
        in      a,(y1)          ; get Y value from console 1
        ld      (hl),a          ; store in memory
        inc     l               ; increment to next data address
        in      a,(x2)          ; get X value from console 2
        ld      (hl),a          ; store in memory
        inc     l               ; increment to next data address
        in      a,(y2)          ; get Y value from console 2
        ld      (hl),a          ; store in memory
;
;       Restart timer
;
        ld      a,timval        ; get value to be used for countdown
        out     (timout),a      ; send out to timer register
;
;       Restore registers and return to interrupted routine
;
        pop     hl              ; restore HL pair
        pop     af              ; restore AF pair
        ei                      ; enable interrupt system
        reti                    ; return (ret could have been used)
;
;
        end     start
```

SCADA



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Continued on next page

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32 K Classroom

32K Classroom will be a regular department aimed at explaining some programming techniques using 32K Structured BASIC. The main emphasis will be placed on conveying the "how to" with secondary emphasis on coding effectiveness. These articles will cover some of the intricacies of coding with Structured BASIC and interfacing with the operating system. Potential solutions to various problems will be discussed. Your comments and ideas for future articles are welcome.

ABSOLUTE ADDRESS

Absolute address cursor control is a function which creates some problems for many Cromemco users. This function causes problems because there are four parameters which must be transmitted as one single string. This article will detail the steps required to absolute address the cursor on an 80 character wide by 24 line CRT terminal. This discussion will be confined to the 3102 Cromemco terminal with a table of other popular terminals listed at the end of the article.

The code for absolute address in the Cromemco terminal manual is [ESC] [Y] [ROW] [COLUMN]. But there is no indication that an offset is required to make the code function properly. The offset for the Cromemco 3102 terminal is 31. The row and column create a matrix on the screen. The row is the vertical address and the column is the horizontal address. This will allow you to address the cursor in any one of the 1920 locations. The row part of the code relates to the lines on the screen. Line one (1) is the top line on the screen. The lines are counted down to line twenty-four (24). The column part of the code relates to the character location on the line. Each line provides addresses for eighty characters which are counted across the screen from left to right.

One way to set up the absolute address code is to create a string, reference the following example.

```
A$ = CHR$(27) + "Y" + CHR$(X + 31) + CHR$(Y + 31)
     [ESC]  [Y]  [ROW]  [COLUMN]
```

Remember: The 31 is the offset for both row and column.

The string is set up to allow the programmer to change the row and column by only changing the value of X and Y.

The sample program which follows will demonstrate the use of the absolute address function on a 3102 Cromemco terminal.

```
 10  DIM A$(10)
 20  B$ = CHR$(27) + "E"
 30  INPUT"R & C [2,20]: ",X,Y
 40  IF X<1 OR Y<1 THEN GOTO 100
 50  IF X>24 THEN GOTO 10
 60  IF Y>80 THEN GOTO 10
 70  A$ = CHR$(27) + "Y" + CHR$(X + 31) + CHR$(Y + 31)
 80  @B$;A$;
 90  GOTO 10
100  END
```

The program will request you enter the row [R] and column [C] address in one input statement. Then the program will clear the screen and print the next input statement at the address entered in statement 30. The program is a loop which continues to return to the input statement 30 until you enter the value of zero (0) in either input value "X" or "Y". The dim statement will set the length of string A$ to ten characters. The statement 20 sets the value of "ESC" "E" for clear screen to variable B$. The values entered in statement 30 are plugged into the "X" and "Y" variable of the A$ string. The next three statements are error traps. Statement number 40 is checking if "X" or "Y" are above the value of "0". Statement number 50 is checking if the row value "X" is above "24". Statement number 60 is checking if the column value "Y" is above "80". Statement number 70 defines the four parts of the absolute address. The values entered in statement 30 are used by the A$ string each time the program passes through statement 70. The program will move the input statement around the screen as you enter different values into the input row and column variables.

The following table gives you the codes for a few popular terminals used by Cromemco owners.

pu table

If you plug the appropriate clear screen and absolute address code into the program the program will run on each of these terminals.

About the Author

Michael Turnage is the President of Turnage & Turnage Ltd., a software development company in Long Beach, California. He has been programming in BASIC for seven years. His experience includes Data General, IBM 34/38, Hewlett Packard and Cromemco computer systems. Some of the custom software packages written are Data Base, Mailing List, Independent Trucker, Financial, Income Tax, and Engineering Utility.

TERMINAL	CLEAR SCREEN	ABSOLUTE ADDRESS
3100 & 3101	B$ = CHR$(27) + "E"	A$ = CHR$(27) + "F" + CHR$(X + 63) + CHR$(Y + 31)
3102	B$ = CHR$(27) + "E"	A$ = CHR$(27) + "Y" + CHR$(X + 31) + CHR$(Y + 31)
SOROC (IQ 120)	B$ = CHR$(27) + "+"	A$ = CHR$(27)"=" + CHR$(X + 31) + CHR$(Y + 31)
REGENT 100	B$ = CHR$(12)	A$ = CHR$(27) + "Y" + CHR$(X + 32) + CHR$(Y + 32)
INTERTUBE (1.7)	B$ = CHR$(12)	A$ = CHR$(27) + "Y" + CHR$(X + 32) + CHR$(Y + 32)
HAZELTINE 1500	B$ = CHR$(126)	A$ = CHR$(−126) + CHR$(17) + CHR$(X + −1) + CHR$(Y + 31)

SCADA

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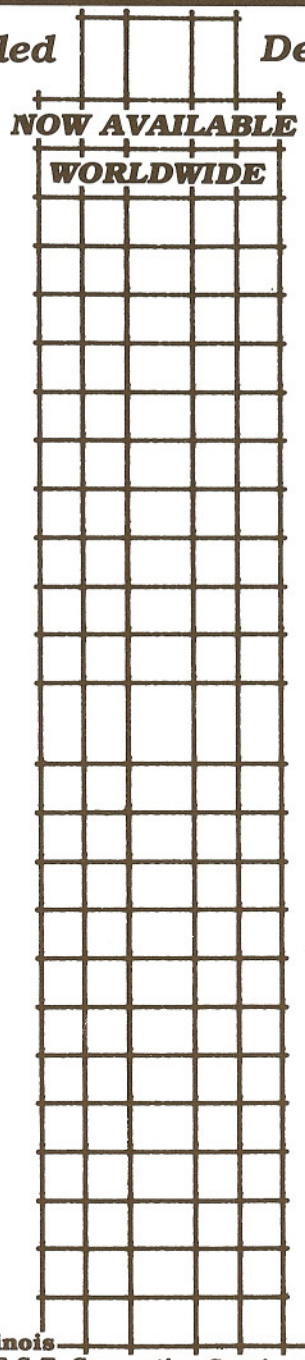

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Easier Disk Insertion in 299B Drives

Andrew Smith of Microcentre, Ltd. in Edinburgh, Scotland dropped by on his way home from NCC with a tip that provides an easy remedy to the difficulties involved with inserting disks into 299B drives. It seems that there are V-shaped guides below and above the head. These guides hold the diskette in place via spring tension. As the disk is inserted it must force the guides apart by working against the springs. Often, the guides resist the disk. To overcome this problem, he suggested that a sharp pencil — the softer the lead the better — be **gently** inserted between the opening points of the guides and rubbed against those points to deposit a thin coating of graphite on the guides. This will lessen the resistence level and provide the diskette with easier entry which, in turn, will protect the edges. We must stress that this procedure should be approached with extreme care, and no experimental poking with the pencil should be attempted. After all, pencils are pretty expensive these days.

New Book Highlights Cromemco

Industrial Design with Microcomputers, by Steven K. Roberts (Prentice Hall, 1982), is a book designed to familiarize engineering management with some of the applications of computer aided design (CAD). It offers examples of micros in industrial applications, and utilizes Cromemco systems — both hardware and software — throughout as the primary source from which data and examples were built.

Jency Kelly of Royal Data, Inc. in Titusville, Florida is acknowledged by Roberts for his assistance in the author's understanding of CROMIX.

While not highly technical in nature, the book offers a valuable overview of some of the possible applications of micros in industry, and could become a necessary reference piece for corporate planners.

Arizona Users' Group Report

The Arizona Association of Cromemco Users featured on-line instruction in 32K Structured BASIC at its July meeting in Phoenix. The August meeting will continue with 32K instruction as well as introducing KSAM and data file manipulation with special emphasis on structured programming. The August meeting will be conducted by Howard Paley. Anyone wishing to affiliate with this group can contact JoAnn Drake at (602) 993-9589.

New Games Package

Analytic Associates recently sent us their newest release of SUPER ADULT GAMES ARCADE. Not only is SUPER STAR TREK — an improved version — included, but other games have been added to the package. It now contains SPLAT (Pull the ripcord over different planets, with differing gravities, and see if your chute opens before you land); LIFE (population simulation of a society through as many generations as you want to play — gets a little boring after a few hundred years); HAMMURABI (balancing the ecology of Sumeria over a ten-year period as governor — a challenge); PSYCHIATRIST (just what the doctor ordered on those "Murphy's Law" days); FOUR-IN-A-ROW (try to beat the computer at vertical tic-tac-toe — a humbling experience); and of course, SUPER STAR TREK, the most sophisticated game in the package. If games turn you on, and you have the price of a few movies (with dates) laying around, contact Bob Feakins at (213) 541-0418 for his latest answer as to why TV is losing ground to interactive entertainment like his SUPER ADULT GAMES ARCADE.

Can Anyone Recommend a Paper Tape Reader?

Andrew Parsons in Hamilton, Bermuda is looking for recommendations for paper tape readers that will handle one-inch paper tapes that he can operate off of his System Three with TU-ART. He would appreciate competing sources with list prices if possible. He can be reached at the Public Works Department, P.O. Box 525, Hamilton, Bermuda. His phone number is (809) 295-5151. Please send us a copy of any information so that we can keep it on file for future inquiries.

Rave Reviews for PlanMaster

Last February, we saw PlanMaster demonstrated for a grup of dealers during a training seminar at Cromemco. There was a lot of dissatisfaction, and there were a lot of suggestions offered by the dealers. It seems that Version 2.10, as released just a few weeks ago, took the dealer's comments very seriously. One user who had been using CalcStar reported that PlanMaster, as released, is quicker, more user-friendly, and generally easier to use. He further said that it incorporates the best features of the best of the financial spread sheets. Many of us have waited for a long time for PlanMaster, but the end result may have been worth the wait.

Interface for Diablo Letter Quality Printers

Pat McGuire, a consultant in Buena Park, Calif., and early member of IACU, reports that an interface has been developed that allows a Diablo printer (such as the 1600 series, or the 1345 OEM model) to be connected to the Cromemco PRI port. This eliminates the need for special drivers when standard spacing is satisfactory. The device consists of a special cable and switch box which permits the operator to select between a Diablo and a Cromemco 3703 (or other Centronics-type parallel printer) without affecting the software. The interface automatically supports bi-directional printing similar to the 3703, but with an 800-character buffer. Under CDOS, this provides a maximum throughput. Under CROMIX, at present, delays must be included to avoid overflowing the buffer. A new interface is due to be released soon that will eliminate the need for delays in CROMIX. Contact Pat at (714) 898-3245 for additional information on this device.

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* The MCU board is needed for the error-correcting memory, however one MCU controls up to eight memory boards.

** The 68000 Compatible Cromix is necessary because the previous Z-80 compatible version will not work with the 68000.

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Soft Tips

SOFT TIPS is a regular column aimed at providing software oriented hints and ideas for non-programmers. Members are encouraged to send in tips that can help a user better use his/her system. SOFT TIPS is designed to put forth ideas that are general in nature. The column is edited by Norman Vadnais, Director of Cromemco Activities at Applied Research, Inc. (ARI), a Los Angeles Area dealer. Members contributions can be sent to SOFT TIPS, in care of I/O News.

LETTING CROMIX RUN YOUR SYSTEM

The CROMIX Operating System has many features that are unfamiliar to most 8-bit micro users, and yet are very easy to understand and use. For smoothest operation of your system, these features should be implemented. The first step is to organize the users on the system. I still find many systems designed with everyone as super-users: this is a waste of an important CROMIX feature and can prove to be deadly. Super-user status (a user number of 0) should be used only when absolutely necessary. Even the system operator should have a second, non-super-user, password for his day-to-day operation on the system. The trouble this can save through avoidance of simple mistakes and/or abuse is well worth the time spent during the initial setup and orientation. More on easier CROMIX use in future SOFT TIPS.

USER MEMORY UNDER CDOS

Programs currently being written for CP/M, and its derivative operating systems (including Cromemco CDOS), are requiring more and more space for their operation. Therefore, user program area (referred to as TPA, Transient Program Area, by Digital Research) is becoming an increasingly important consideration when looking for software for your CDOS based Cromemco system. As we all know, CDOS takes up more space than CP/M and, in some cases, this can be the difference between running or not running under CDOS. Your alternatives when a larger user area is necessary to run your application are: (1) modify the CDOS I/O drivers—usually increases user area by less than 256 bytes, not your best alternative; (2) purchase CP/M from a licensed distributor—make sure it is pre-set for Cromemco systems, normally all Cromemco based software is lost, utilities are not as good as Cromemco's; or (3) upgrade to a single-user CROMIX system—the CDOS Simulator takes up less RAM than CDOS or CP/M, all extra features of CROMIX are obtained, CDOS and CP/M programs generally run faster under CROMIX. The third option has added attraction if you are considering a later upgrade to a multi-user system.

HANDY COMMAND FILES

In a previous edition of TEC TIPS (January/February 1982), Richard Quinn spoke of command files to fully utilize your system printer. Though this is an excellent example of the usefulness of command files, it is only the tip of the iceberg. In every edition of SOFT TIPS, at least two command files of as general an interest as possible will be featured, along with hints about how you can develop your own command files.

In writing command files, be as clear and concise as possible, avoiding unnecessary steps whenever possible. Beware! Making your command files so encryptive no-one can read them is just as much a problem. Also, never do more than necessary in a command file, many times a good idea has gone awry because a designer did not know when to quit. Speaking of quitting, I think I will, and here are our first two command files.

Name: TOF or FORMFEED
Purpose: Top of Form or Formfeed on printer receiving spooled output, for the purpose of removing the last printed page.
Setup: None required
Listing:

```
spool -k --->*/dev/null
spool -p 9 </dev/null >*/dev/null
```

Notes: The first line, by use of the -k option of the spool utility, deletes any previous TOF waiting in the print queue, this ensures only one TOF in the print queue at any time. The '>*/dev/null' directs all output, including error messages, to the null device (otherwise known as nowhere or the CROMIX Black Hole). The second line again uses the spool utility to generate a new top of form. The option '-p9' gives the newly created spool file a priority of 9, the lowest allowed; this ensures that the top of form will be printed after all other spool files. The '</dev/null' on the command line initiates redirected input from the null device, which is empty. The effect of spooling an empty file is a blank page on the printer. Mission accomplished! As before, all output is also directed to the null device. It is also a good idea to add a user to your system with name and password of TOF that calls this command file and then exits, for users who have alread logged off and require a top of form.

Example:

```
%spool -la
```

Filename	User	Seq	Device	Pri	Pages	Lines	Copies
adveradd.cmd	john	1444	6:5 prt	5	2	119	1
proskill.cmd	norman	1445	6:5 prt	5	3	138	1
adverdel.cmd	john	1446	6:5 prt	5	2	64	1
prosprch.cmd	norman	1447	6:5 prt	5	3	138	1

```
%tof
%spool -la
```

Continued on next page

Filename	User	Seq	Device	Pri	Pages	Lines	Copies
adveradd.cmd	john	1444	6:5 prt	5	2	119	1
proskill.cmd	norman	1445	6:5 prt	5	3	138	1
adverdel.cmd	john	1446	6:5 prt	5	2	64	1
prosprch.cmd	norman	1447	6:5 prt	5	3	138	1
----	norman	1448	6:5 prt	9	1	0	1

%spool referenc. txt
%spool – la

Filename	User	Seq	Device	Pri	Pages	Lines	Copies
proskill.cmd	norman	1445	6:5 prt	5	3	138	1
adverdel.cmd	john	1446	6:5 prt	5	2	64	1
prosprch.cmd	norman	1447	6:5 prt	5	3	138	1
referenc.txt	norman	1449	6:5 prt	5	3	136	1
----	norman	1448	6:5 prt	9	1	0	1

Name: [PROGRAM] Same as original CP/M or CDOS Software

Purpose: To implement a CP/M or CDOS package under CROMIX with all of its capabilities. Problems arise when the original [PROGRAM] conflicts with the standard modes of the terminal. An example is a [PROGRAM] having C (control – C) as a possible input.

Setup: Rename the original [PROGRAM] that resides in the /bin directory, but keep the name similar (so it is still recognizeable, see example below).

Listing (examples):

To run MicroPro's WordStar

1) Rename /bin/ws.com to /bin/wordstar.com
2) Setup /cmd/ws.cmd as follows:

```
mode -ec -crdev -ab raw
wordstar #*
mode ec crdev ab -raw
```

To run Ashton-Tate's dBase II

1) Rename /bin/dbase.com to /bin/dbase2.com
2) Setup /cmd/dbase.cmd as follows:

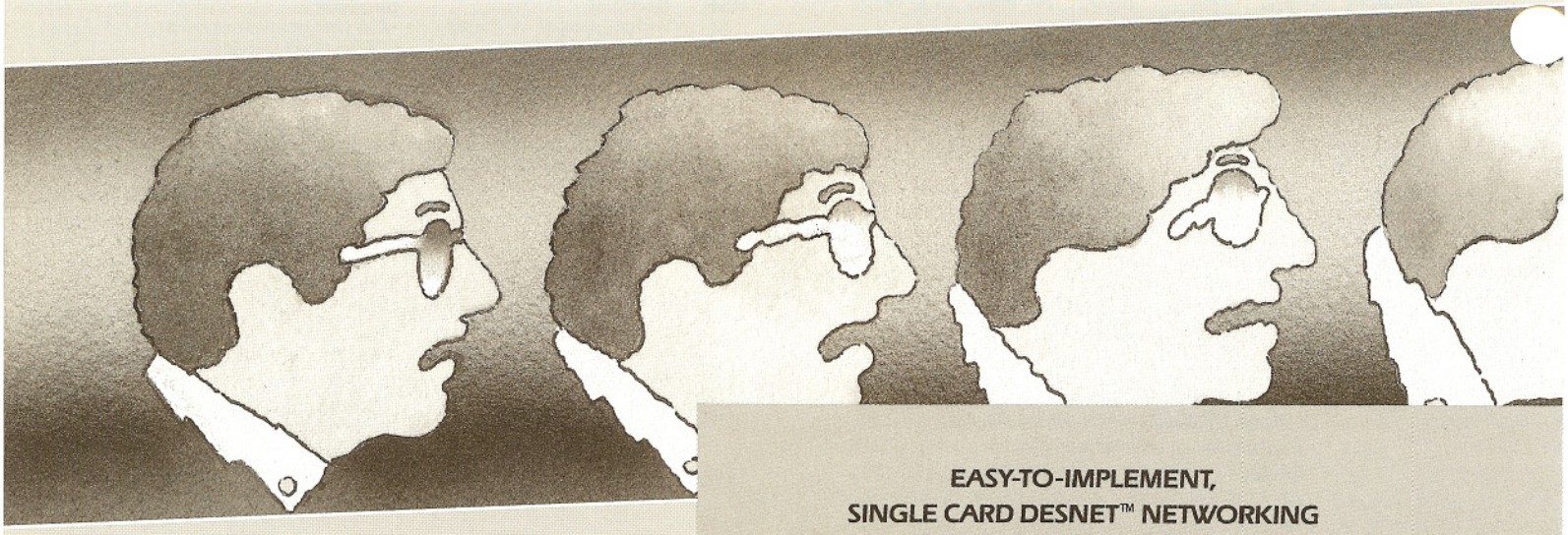
```
mode -ab
dbase2 #*
mode ab
```

NOTES: The first line of the command file alters the mode of the terminal to adapt to the [PROGRAM] and its features. By using the chart below, determine the modes needed for proper operation of your [PROGRAM]. Be sure to use only those required. The second line calls the original [PROGRAM] under the new name assigned. The "#*" in both examples is optional, but allows full compatibility with the original [PROGRAM]. The "#*" will pass the entire command line to [PROGRAM], just as it is passed in CP/M or CDOS (for examples, 'ws letter.txt' and 'dbase mainmenu.cmd' will both work only if "#*" is included in the command file). The last line of the command file returns the user's terminal to its normal operating state by reversing everything in the first line.

Example:
If implemented correctly, [PROGRAM] should work the same as it did in CDOS or CP/M—no example is necessary.

MODE TABLE

Mode	Operation	Necessary
– ab	Allows input of C during program execution	C is part of the command choices of [PROGRAM]
ab	Aborts program upon input of C	Reverses effect of '– ab'
– crdev	Allows separate input of Carriage Returns (the RETURN key or M) and Line Feeds (the DOWN-ARROW cursor key or J)	[PROGRAM] treats Returns and Line Feeds differently, most commonly needed in word processing programs
crdev	Treats all Returns and Line Feeds as Line Feeds	Reverses effect of '– crdev'
– ec	Characters input are not echoed (i.e., printed) back to the terminal by CROMIX	[PROGRAM] echoes all characters input
ec	All characters input are echoed by CROMIX	Reverses effect of '– ec'
raw	Allows input of S and Q during program execution	S and/or Q are part of the command choices of [PROGRAM]
– raw	Controls program output with S (to stop output to the terminal) and Q to resume output to the terminal)	Reverses effect of 'raw'
– pa	Allows continuous output of text on terminal during program execution	Standard mode of system is 'pa'
pa	Stops output to the terminal after 24 output lines and awaits a Q	For more controlled program execution



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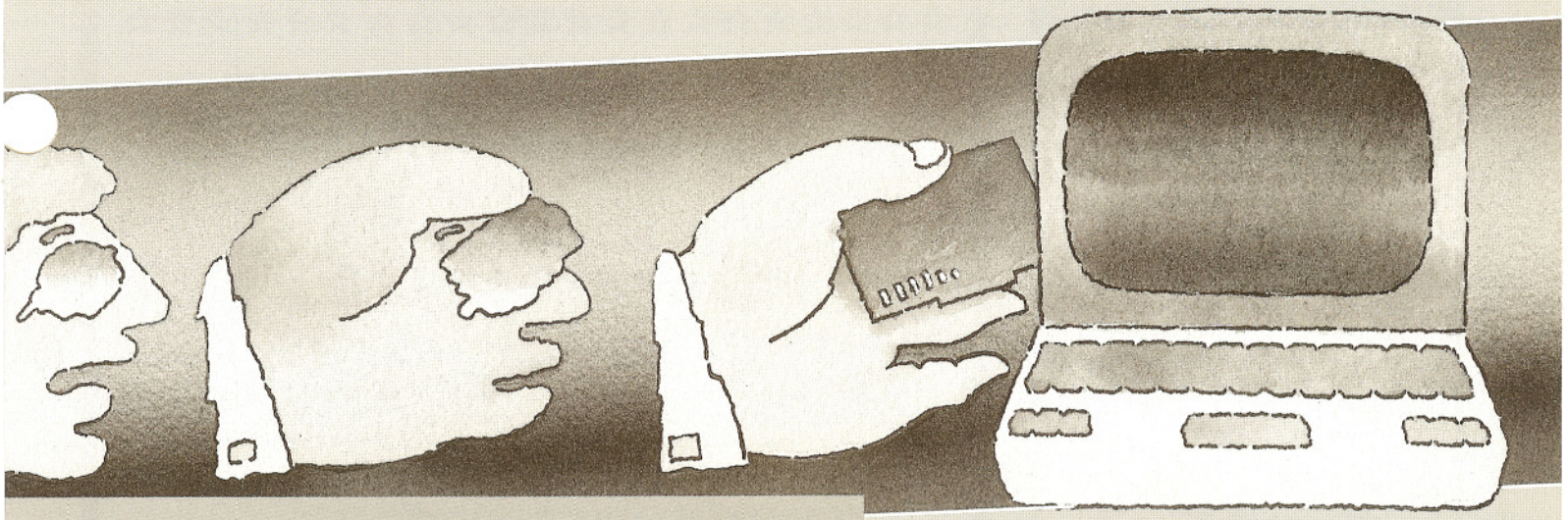

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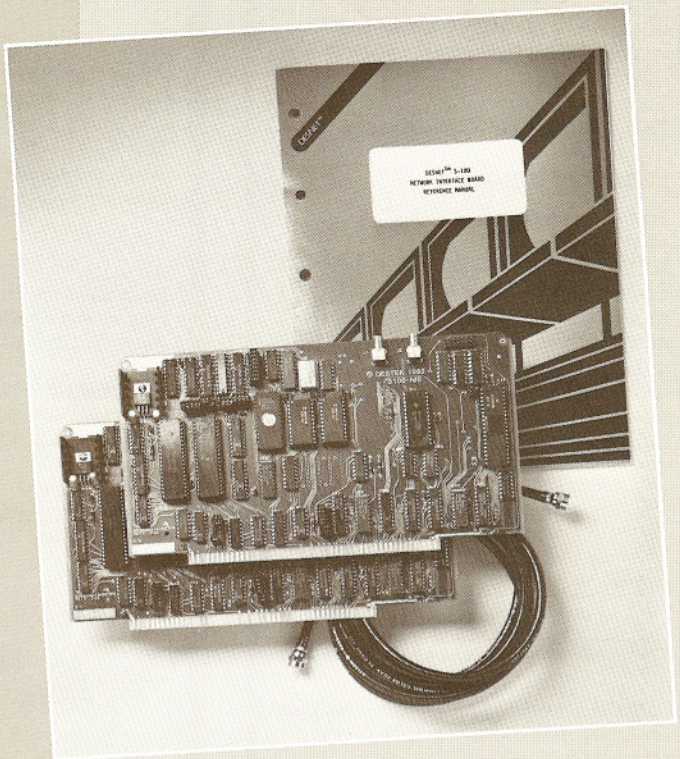

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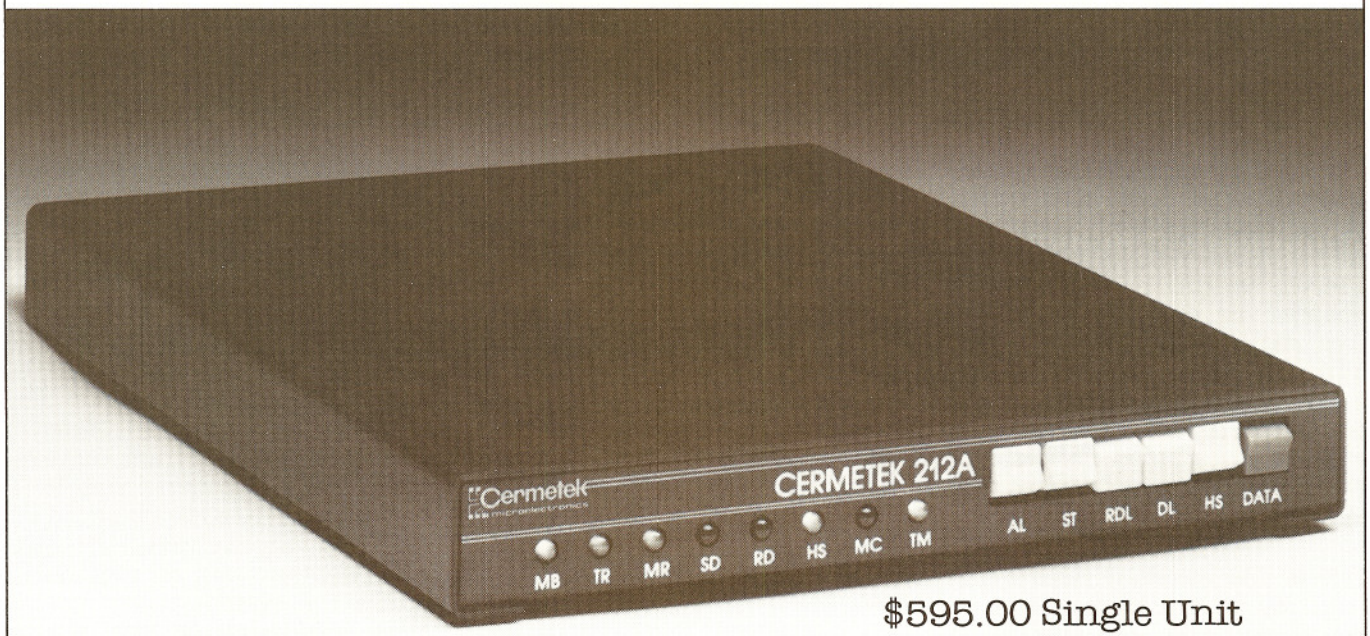

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Expert System in Occupational Safety and Health Engineering

By Leo Greenberg, PhD, PE, CSP

A major new development in computer application is the use of **expert systems.** An expert system is a software package which is designed to transmit to the user the knowledge and experience of the expert author(s) of the software. In this manner, a user possessing lesser expertise, or not in possession of the store of data available to the author(s), can perform his/her task at a higher level of expertise than otherwise possible. Additionally, the time saved in the use of the software, as compared to conventional procedures, can be substantial. Put very simply, an expert system obtains certain basic information from the user which it analyzes, perhaps asks for more data, then makes use either of its data bank or model(s) of the phenomenon in question, or both, to reach a certain set of conclusions. The literature reports the availability of an expert system in medical diagnosis, and another in geophysical analysis. There may well be others available, and surely others are in the process of preparation.

Computers have been in use in the field of occupational safety and health, but mainly as devices for storing records or other information, and/or for statistical analyses and reports. Both the American and British professional literature have been recently devoting papers to the subject of application of microcomputers to this field, with a number of uses demonstrated. However, so far, each application is intended to satisfy a certain specific and narrow need. There has as yet been no mention of the possible use of an expert system in this field of specialization.

Ever since the enactment of the Occupation Safety and Health Act (OSHA) in 1969, an increasingly greater demand has been made of the employer to provide a broader range of safety and health activities in the workplace, and this, at a higher level of intensity. This has meant a substantial increase in the number of safety practitioners employed by all sectors of employment, with the consequent increase in the cost of the safety effort. One must also be aware that the practice of safety has generally been highly labor intensive. This is partly due to the nature of the work, but more likely because too little effort has been made to seek more efficient ways of doing the work. In most workplaces, occupational safety and health is not the glamorous activity to which management would want to devote substantial energy, time and money for research and development, unless forced to do so. Generally, then, the resources allocated to finding ways of doing safety work more efficiently are substantially less than those devoted to searching for better manufacturing and distribution methods. The safety department normally doesn't have the ready access to the mainframe computer that the manufacturing or marketing departments have. Consequently, then, safety practitioners are often less computer oriented than their colleagues in other fields of specialization.

As a result, it is not known that an effort has so far been made to write an expert system in this field, using Federal or corporate monies for system development. And if one were available, not many smaller firms would or could take advantage of it. One should point out that proportionately more safety problems are encountered in the smaller workplaces than in the large ones. Hence, an elegant solution obtainable with a $1,000,000+ computer would miss quite a few potential beneficiaries.

I therefore felt that, what with the availability of highly capable yet very modestly-priced microcomputer systems, it should be possible to write an expert system for the field of occupational safety and health engineering which could then be used real-time, at very modest cost. In this way, lesser-qualified safety practitioners could perform their work at a higher level of competency, and substantial time savings could be obtained by mechanizing various procedures, such as data look-up, computations and data recording. It seemed to be that all this could be achieved at quite low cost to the employer. Based on the above analysis of the problem and the seemingly obvious solution, I set about putting to the practical test my hypothesized solution.

There was no dearth of microcomputers to select from. However, since this undertaking was to be self-financed, a modestly-priced system was very desirable. Yet, since the intention was to subsequently use the system in serious business environments, one wanted more than an inexpensive plaything Surveying the market and information available about the various manufacturers, the Cromemco System 0/D seemed very interesting. It is compact, reasonably priced, yet coming from a highly-reputable manufacturer. In truth, had the choice been made a few months later, I would have selected the System 1, since it yields a higher cost/benefit ratio. However, at the time, System 1 did not exist.

A major objective was to make the use of the entire system as simple to the user as possible, expecting that most potential users were not only "computer illiterates," but were probably scared of computers, of any size. Hence, to make the system user friendly, I decided early on to use a minimum of complications. For example, one of the applications planned was the creation of an employee exposure record file. For this,

Continued on next page

the Data Base Management System would be a natural solution. However, the user would have to read and understand at least one additional user's manual, with its scary terminology. Instead, I decided to write the necessary software myself, even if it were to be less flexible and comprehensive than the DBMS. Similarly, some of the software could more readily be presented in FORTRAN, but this, again, would complicate matters, as far as the user was concerned. As a result, I decided to make matters as simple as possible for the user, by writing everything in Cromemco 16K Extended BASIC. The choice of this version of BASIC rather than the 32K version was based mainly on the fact that the latter consumes so much RAM that not very much is left for the applications program. By now, with the precipitate drop in the cost of RAM, using a system with 128K of RAM might be the preferred solution.

No one would want to claim that Cromemco's 16K Extended BASIC is the best of all possible BASIC's, and it isn't. But it certainly should not be dismissed lightly since it possesses quite a few worthwhile features. Undoubtedly, however, a major shortcoming is Cromemco's manual, especially as it relates to the writing of files. The language itself is presented well by the Manual though a few serious omissions can be called to mind. But file handling can be very tricky if you don't pay careful attention to various fine points, and the Manual never bothers going into details about this. I spent many very frustrating and time-consuming days in discovering some of these unwritten rules of file handling.

In any event, tears aside, the system that I have succeeded in putting together is modular. On signon, one is presented with some introductory material and then the main menu (see Fig. 1). The selection made by the user then brings him/her to the local menu, and finally, to the specific program of choice.

Explanatory material is quite liberally sprinkled throughout. Error trapping is used wherever possible, so as to avoid erroneous data entry. If the ESC key is depressed, all files are closed and the user is given a choice between reuse of the program, return to the main or local menu, or leaving the software environment. The program diskette is put into drive **A** while the data

Continued on next page

MAIN MENU

The following are the modules which presently comprise the **Safety-Mation** software package:

Module Number	Module Name	Description
1	TOXREG	Input, output and updating of physical, toxicologic and industrial hygiene data of toxic substances
2	RECORDS	Recording and retrieval of employee exposure records, recording and retrieval of employee accident/injury records
3	STANDARD	Computation of applicable TLV/PEL, evaluation of exposures
4	NOISEMOD	Noise-related computations, including of noise exposures
5	ACOUSTIC	Computation of acoustic characteristics of a room
6	PLANNING	Programs to assist in health/safety plan design and evaluation
7	COMFORT	Computation of the Wind Chill Index and heat stress exposure
8	VENTILTN	To compute the required air dilution rate for health and fire and explosion prevention

Continued from page

Expert System in Occupational Safety and Health Engineering

diskette is in drive **B**. Although the software is modular, there is interconnection between quite a few of the programs, as they make use of one another's capabilities.

Although some laymen may be unaware of this, the practice of occupational safety and health can require quite a bit of computation and analysis, and this software package has attempted to lighten this burden on the practitioner. The software package, called **SafetyMation,** set for itself several objectives. First, it should be easily usable by a person knowing practically nothing about computers, and even less about computer programming. Second its use should enable a person of low or moderate professional competency to perform work of a higher level of competency because the material in the programs would fill the void with data and professional judgment. And third, the highly competent professional should be able to save substantial time by having the computer perform as many time-consuming tasks as possible, leaving it for him to devote his time to those matters truly requiring a high level of expertise.

The project being reported on is well advanced, yet it can continue for a long time, since the potential scope for further activity is almost limitless. Nevertheless, the material already available can be quite useful to the practitioner.

Specifically and briefly, the following modules have already been prepared.

1. A **Toxic Substances Register** for the entry and output of a broad range of physical, toxicologic and industrial hygiene data for chemical substances.

2. A module for the evaluation of a variety of **exposures to hazardous materials,** with an option to record the results in the employee's exposure record.

3. The analysis of **noise exposure problems** with an evaluation of their conformance with standards. Here, again, an option is provided to write employee exposures into the employee's exposure record.

4. **Employee exposure records** can be entered independently, after which the records may be searched for in any combination of the variables entered. Similarly, **employee accidents and occupational diseases** may be recorded and searched for by means of a pair of programs comprising a part of the RECORDS module. One should point out that safety law requires the maintenance by the employer of exposure and accident/disease records for a specified number of years.

5. One can analyze a given enclosure (room) for its important **acoustical properties,** and then determine the expected sound pressure level at a specified point, given the sound power of a noise source. This helps one to anticipate noise problems and then design an appropriate solution.

6. One can compute the **Wind Chill Index** and, for the other extreme, the heat exposure of persons exposed to hot temperatures. Moreover, to determine whether a given task, combined with the evaluated heat exposure, may cause heat stress, a metabolic task analysis may be performed.

7. A number of programs are provided to ease the burden of planning and implementing a plant safety program. These include a program to perform **Pareto analysis,** another to compute and plot a **cusum chart,** another still for computing and plotting a **p-chart,** one to plan a random times sampling program, etc.

8. The last module, which will bear more development, deals with the design of **dilution and exhaust ventilation** to prevent health, fire and explosion hazards.

EVALUATION

One of the objectives in undertaking this project was to demonstrate that the hypothesized expert system could be constructed to operate satisfactorily on a microcomputer system, using a language such as BASIC. The experience gained so far has indicated that this has been achieved. Moreover, use of the software is simple, requiring only the turning on of the computer to be in

Continued on next page

use mode, since STARTUP.CMD is used to load and run the main menu.

Since most of the programs are not of the "numbers crunching" type, results are generally obtained instantaneously, or almost so. Where file searches are required, more time is, of course, needed. Those users accustomed to the very rapid operation of mainframe computers, may be disappointed by the microcomputer's slower operation, but they certainly will not be unhappy with its much lower cost. On the other hand, the results obtained by means of the **SafetyMation** software are so much faster than when obtained through manual manipulation, that the cost of a system can quickly pay for itself. Bear in mind, also, that it is now possible for less expert staff to carry out certain analyses, with the aid of the software, of which they are otherwise incapable. This feature can be attractive not only to private employers in industrialized countries, but also to developing countries, where expert personnel are in very short supply.

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  FASTBACK is cost effective.
- Transfer data from one hard disk to another, or transfer from floppy-to-floppy whether CDOS or CROMIX disks.
  FASTBACK is versatile.
- Utilize our existing equipment. By backing up onto floppies we no longer have to invest in expensive peripheral equipment. And floppies are so much more available than hard to find tape cartridges.
  FASTBACK is easy.
- Preserve our data using the automatic installation feature which checks the system and adjusts itself for proper default operations. The simple menu operation ensures successful back-up by anyone. It even checks to be sure the disks are in the proper order.
  FASTBACK is safe.

Estimated Times	Drive Types	Number of disks
12 min.	8" DS/DD	9*
19 min.	8" SS/DD	18
23 min.	8" DS/SD	22
46 min.	8" SS/SD	43
18 min.	5" DS/DD	27**
30 min.	5" SS/DD	54
240 min.	5" DS/SD	60***
500 min.	5" SS/SD	120***

*System Three with Persci 299's, 16 FDC and HDD-11/22.
**System Two with 5" Tandon, 16FDC, and HDD-11/22 or Z2-H with 16FDC.
***Not recommended but supported by FASTBACK.

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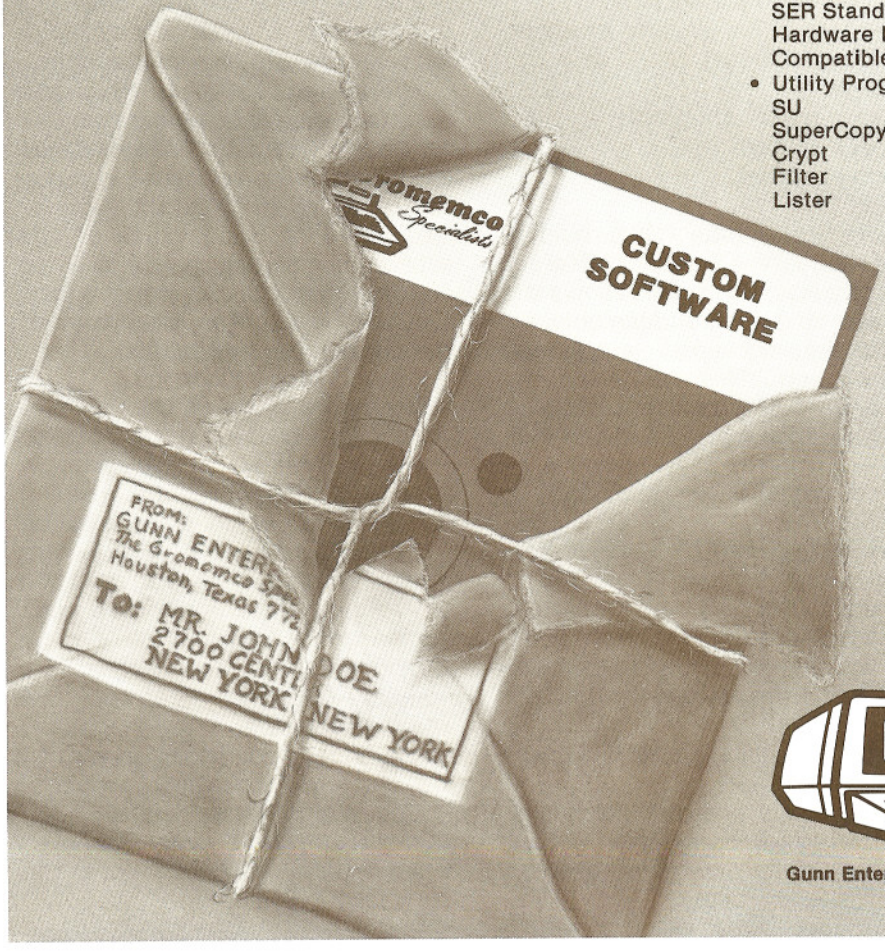

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The Development of a Microcomputer Based Radar System

By Vidar Solli, M.Sc.

Radar is an instrument which allows us to continuously monitor our surroundings. In a simple manner radar makes it possible to determine the distance to and the direction of a given object, and some radars can determine an object's speed.

Radar works with electromagnetic waves, and uses wavelengths from less than one centimeter up to more than one meter. A radar set consists of a transmitter, a receiver and an antenna.

The transmitter generates high frequency electric energy which is relayed by wave relays as electromagnetic emission to the transmitter antenna. The antenna relays this energy to the atmosphere. A small portion of the transmitted energy hits the object, where some is absorbed and the rest reflected. The portion of reflected energy detected by the receiver antenna is relayed to the receiver.

One of the shortcomings of most of today's radars is the comparatively poor quality of the display. Cromemco Color Graphics can improve this situation.

The SDI Based Radar Display

The system built around Cromemco's SDI cards is meant to replace/enhance existing radar displays when used in conjunction with a radar set. (Figure 1).

Instead of the displays now in use, a color monitor is used in this system. The radar picture will appear in clear colors, meaning that much better contrasts are achieved than in existing displays. Another advantage is that the picture can be easily read in daylight.

In addition to the echo from the radar, additional information may be added to the display. The fact that color graphics are being used makes it possible to add information in different colors, making the picture even easier to read. Such information (in addition to the radar echo) could, for example, include:

— Landscape (particularly for shore-based installations)
— Buoys
— "Auto track" of objects
— Speed vectors
— Grid patterns
— Text

Shore based installations could include a landscape in a color different from the echo itself. This allows the operator to detect "hidden objects" such as ships docked at piers, hidden in fjords, etc. This should be very useful for traffic control in smaller ports, narrow sounds and the like. The landscape is then provided as colored areas rather than only a coastline.

The system may be installed anyplace where a radar is already in operation. The only requirement is that the necessary signals are available. The signals needed for the system to perform the display function are:

— Video signal (reflection signals from the receiver)
— Sync signal (indicates transmission from the transmitter)
— Syncro signal (indicates the direction of the antenna)

The video signal varies in amplitude depending on the intensity of the reflected signal. The system is built to receive different signal types.

The sync signal is a short pulse syncronized with the transmission of the radar pulse from the transmitter. This signal is syncronizing the echo-reading electronics. A delay line on the sync pulse has been included to compensate for time lags due to such variables as long cables between transmitter and antenna.

The system has been developed for an antenna with a syncro emitter for direction finding. The syncro signal is converted to digital information which again forms the basis for calculation of the position of the echo on the screen. A possibility to add an offset to this signal exists. This means that the orientation of the display may be changed.

Display Features

Below are some of the features which may be added to the system. These features are largely software controlled, meaning that adding new features or changing existing features is simple. All features are controlled from a control unit. The control unit consists of a few push buttons with light indicators and a joy stick. The joy stick performs a number of tasks depending on which feature is selected. A window on the screen will continuously display the feature currently active.

— Choice of different ranges
— Filter (echo is only presented when detected twice or more at the same location)

Continued on next page

— Alarm when echo appears or disappears from the screen
— Adding/deleting markers
— True motion
— Activate/deactivate object tracking
— Listing of a given object's distance, direction, course and speed
— Continuous listing of distance and direction to the cursor
— Off-centering of own position
— Positioning the text window
— Adding a grid pattern
— Clock
— Setting of discrimination level (the minimum level of the echo to be presented)
— Auto tracking
— Storing displays/logging on floppy disks
— Changing of the display's orientation
— And much more!

Inasmuch as the SDI generates ordinary RGB and sync signals, the picture may also be copied by a standard video system.

The system has been constructed so that the echo will appear with two intensities (or one intensity if filtering has not been chosen). Another possibility is to use all 16 colors to represent an echo. The consequence of this is that the intensity of the signal will appear through use of the different colors. This, however, will decrease the quantity of additional information which may be included in the picture.

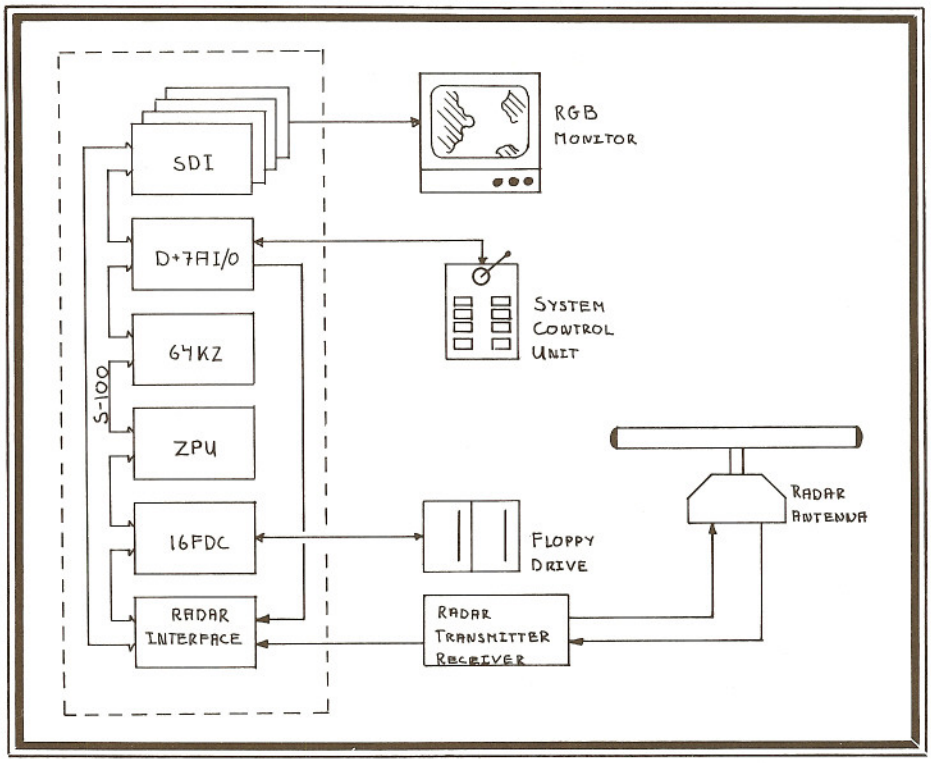
The System's Resolution

The resolution (ability to discriminate) of the system is determined by the frequency at which the echos are sampled. The area covered by the screen is also dependent on this frequency.

Below is a table giving the sampling frequency (FS), the resolution (RS), and the size of the area covered by the screen (at the smallest possible range):

FS (MHZ)	RS (M)	HOR. (M)	VER. (M)
1.00	150.0	57450.0	36150.0
10.00	15.0	5745.0	3615.0
15.00	10.0	3780.0	2410.0
20.00	7.5	2835.0	1807.5
30.00	5.0	1890.0	1205.0
100.00	1.5	574.5	361.5

The resolution indicates the accuracy that distances can be measured. The frequency must be chosen which is best suitable depending on the radar's purpose. A monitoring radar does not need as good a resolution as a navigation radar. The resolution is restricted by the delay in the electronics sampling the echo.



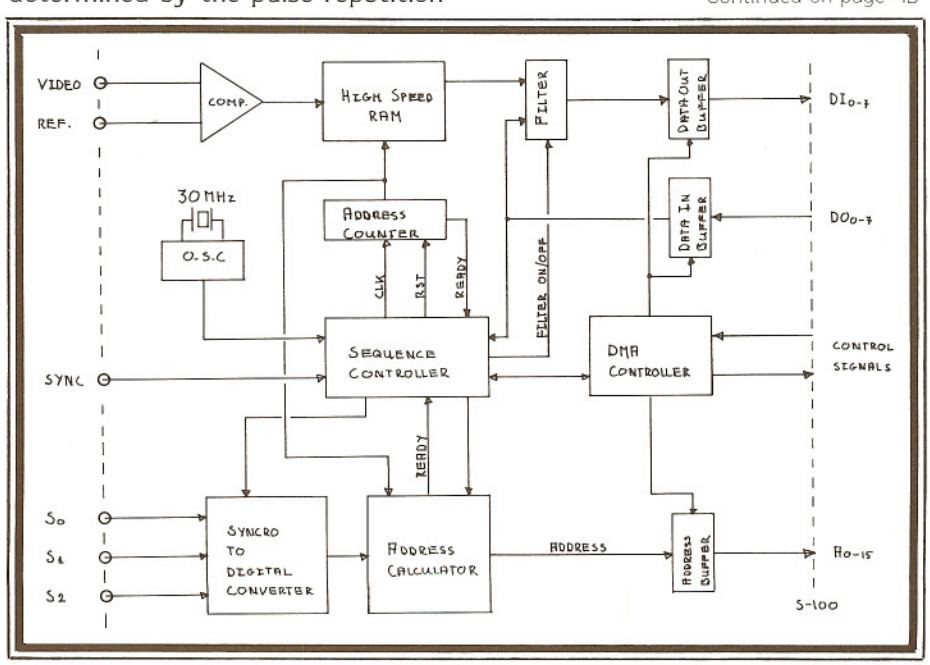
The area covered by the screen is determined by the SDI's horizontal and vertical resolution (medium – > 378 by 241). The largest area which can be covered by the screen is only determined by the pulse repetition frequency of the transmitter. The various areas are chosen as 1,2,3,4, ...times the smallest area.

Software Considerations

The radar interface updates the 48KTPS via DMA. This means that the radar interface must share the bus with the rest of the system. (Figure 2).

In view of the time sharing of the bus, the machine's capacity is reduced by approximately 80%. This demands very exact software. For

Continued on page 43



Budget Graphics for the Cromemco Z2D

by Sean Pentleton

(Editor's Note: The following evaluation is based on a software package developed by Andrew Smith, a director of Microcentre in Edinburgh, Scotland. The package is distributed by Valley Technology, whose address appears at the end of this article.)

Some nine months have passed since I set down my first impressions of the pre-release version of the 12K graphics system for the Cromemco Z2D. My last assessment was based on two to three weeks use and could, perhaps, have been accused of being enhanced by an initial enthusiasm. Having now used the system for nine months, I would not hesitate to recommend it without reservation. It is a high quality product, limited only by the memory which you have available.

Hardware Required:

The following prices are as of March 8, 1982.

(i) SDI Graphics Interface — by Cromemco — approx. $800 (U.S.)

(ii) Monochrome Monitor — by Microcentre — approx. $225 (U.S.)

(iii) RGB Color Monitor — by Microvitec — approx. $515 (U.S.)

A complete system must have items (i) and either (ii) or (iii).

It is therefore possible to have a Black and White high resolution graphics system for less than $1,300.00 (U.S.). What is even more attractive is that for just a little extra (about $1,500.00 U.S.) you can have a high quality, full color, high resolution graphics system which will surpass many of today's systems. It is expandable, as finance allows, right up to Cromemco's own full blown 2 X 48K, multi-page, hard disk system which is well up in the four figure price bracket.

It is worth pointing out that the same SDI board will drive B/W or color monitors — no extras are required when you move to color other than the color monitor. The type of monitor is critical in that it must be an RGB monitor with separate Red, Green, Blue and Sync inputs and that these inputs must be analogue (or linear) inputs. The monitor which I have mentioned above is low in cost but high in quality.

The Software —

12K Graphics Software — by Valley Technology — approx. $140 (U.S.)

This software has been developed to allow you to run the SDI graphics system on the existing 64K memory in 16K Extended BASIC. A great deal of work has gone into the system and it is constantly being improved. All calls are accessed through the BASIC call (USR). These calls are similar to Cromemco's own, making future updating of programs very easy.

The Graphics Calls—

The calls fall into three categories:

(1) Housekeeping calls e.g. initialization, resolution mode, create window, etc.

(2) Low Resolution calls e.g. draw line, circle, filled area, etc.

(3) High Resolution calls e.g. draw line, circle, filled area, etc.

Most of these can be used in the STATEMENT or COMMAND mode. In the text which follows, all the calls are of the format:

Z = USR (J,n,p1,p2,p3,etc.)

where J = 316 memory location for the graphics calls.

n = the appropriate system call e.g. n = 0 for low resolution line and p1,p2, etc. are parameters which must be passed to the call, e.g. the coordinates of the ends of a line X1,Y1 and X2,Y2.

Usually, the first statement in the program will be:

[Ln] J = 316 where [Ln] = Line number

Category 1 — Housekeeping Calls

(1) Initialization

e.g. [Ln] Z = USR(J,68)

This initializes the system and is usually the second statement of the program.

(2) Set Resolution

e.g. [Ln] Z = USR(J,80,R)

If R = 0 then low resolution is enabled i.e. (186(H)x121(V))

If R = 1 then high resolution is enabled i.e. (372(H)x242(V))

(3) Set Color Mapping Register

e.g. [Ln] Z = USR(J,M)

If M = 130 the standard color map is set.

If M = 131 the standard grey scale is set.

(4) Reset a color mapping register

e.g. [Ln] Z = USR(J,84,M,R,G,B)

0 < = M < = 15 : M is the number of the mapping register you wish to alter. e.g. register 0 is the background, normally black. This means that the signal levels for each of the red, green and blue signals are all zero, e.g. R = G = B = 0.

We could set the background to be bright red by using the call

[Ln] Z = USR(J,84,0,15,0,0)

i.e. M = 0, R = 15, G = 0, B = 0 where each of R,G,B are in the range

0< = R< = 15

This call can be very useful particularly in the high resolution mode.

Category 2 — Low Resolution Calls

N.B. Low resolution means (186(H)x121(V)) and that it is possible to program any 16 colors from a possible 4096.

(1) Draw a line

e.g. [Ln] Z = USR(J,0,X1,Y1,X2,Y2,C)

This draws a line from position (X1,Y1) to (X2,Y2) in color C.

Where, 0< = C< = 15

1< = X1,X2 < = 186

and 1< = Y1,Y2 < = 121, the screen origin at (1,1)

(2) Draw a dot

e.g. [Ln] Z = USR(J,2,X,Y,C)

This draws a dot at location (X,Y) in color C.

(3) Draw a filled rectangle

e.g. [Ln] Z = USR(J,4,X1,Y1,X2,Y2,C)

This draws a solid rectangle with diagonal (X1,Y1),(X2,Y2) in color C.

(4) Draw a circle

e.g. [Ln] Z = USR(J,6,X,Y,R,C)

This draws a circle, center (X,Y), radius R, in color C.

(5) Draw a filled circle

e.g. [Ln] Z = USR(J,8,X,Y,R,C)

This draws a solid circle in color C, center (X,Y) and radius R.

(6) Draw text

e.g. [Ln] Z = USR(J,12,X,Y,C,SYS (2 + 0 * LEN(T$)))

This prints the text T$ starting at location (X,Y) in color C. T$ must be previously dimensioned. The text size is (10x8) screen pixels. In the low resolution mode this is quite large text and very suitable for titles. The full character set is available, excluding lower case letters. A few special characters have been developed for special purposes. In fact the whole lower case set has been replaced with special characters (some electronic in nature).

Category 3 — High Resolution Calls

For each of the above six low resolution calls there is an equivalent high resolution call.

(1) Draw a line

e.g. [Ln] Z = USR(J,1,X1,Y1,X2,Y2)

This draws a line from (X1,Y1) to (X2,Y2) where

1<=X1,X2<=372 and

1<=Y1,Y2<=242

All high resolution calls result in white on black i.e. color mapping register 15 (white) on a background of color mapping register 0 (black).

As already explained in category 1.4 both these registers can be reset to give any combination of two colors for registers 0 and 15. This results in high resolution graphics in one color on a background of another color. For example, if register 0 is set for dark blue and register 15 is set for bright red then the above call would have produced a bright red line on a dark blue background.

There are high resolution calls equivalent to calls (2) to (6) in the low resolution set already described. These would be of the form:

(2) [Ln] Z = USR(J,3,X,Y)

(3) [Ln] Z = USR(J,5,X1,Y1,X2,Y2)

(4) [Ln] Z = USR(J,7,X,Y,R)

(5) [Ln] Z = USR(J,9,X,Y,R)

(6) [Ln] Z = USR(J,13,X,Y,SYS (2 + 0 * LEN(T$)))

It is possible with the software to create windows of a different resolution; for example, to label a low resolution graphic with high resolution text, which is half the size of the low resolution text. It is also possible to save on disk a screen image, which has been generated by a lengthy program. This can then be loaded directly back to the screen at some future date, with considerable time savings.

One interesting by-product of the system is the fact that the graphics are displayed on a separate monitor, leaving the normal V.D.U. for display of large areas of say, explanatory text, at considerable saving in terms of memory. This has proved useful in CAL work where it is possible to work with two pages — one for the graphics and one for text. This ensures that only the really vital text appears on an uncluttered graphics screen.

Other Facilities

I have limited the detailed description to the more commonly used functions. There are others —

(1) Implied cursor calls

This is a set of calls where plotting is done relative to the current cursor position as origin.

(2) Autofill

Here an area is automatically filled in solid color. The effect is virtually instantaneous and can be useful.

(3) Dimsave and Dimload

The former saves a screen image on disk while the latter is used to load an image from disk to the screen.

Advantages and Disadvantages

(1) Cost

There are those who would criticize the system as expensive and while I agree that it is not cheap, I would suggest that one is given value for money. However, it must also be said that approximately $1,550 (U.S.) buys a 12K High Resolution Color Graphics System and this is not to be ignored.

(2) Improvement to an existing facility

There has been criticism of the Cromemco system Z2D from Educational establishments on the grounds of its lack of graphics at reasonable cost. This package fills the gap. When one considers the capital investment already made by the original purchase, it seems to be judicious to expand a good basic upmarket system to full graphics for less than one third of its original cost. High quality CAL graphics programs are possible with this system; most of my own programs have been well received by the Ayr Division Science Computer Group. These are listed elsewhere.

(3) Memory

There are limitations to program size because the effective user area is cut to just over 12K when using the graphics in 16K BASIC. Programs are therefore limited to about 12K max. I have overcome this problem by breaking CAL programs into smaller modules run from menu-driven disks. The problem is also alleviated by judicious planning of subroutines which can often be custom-made for a whole suite of programs on a single topic. It would certainly be very welcome to have at least another 16K of RAM. This would allow the system to be run from 32K Structured BASIC. I can see great advantage in being able to use its line editing function during programming. This would be particularly useful when changing some of the parameters in the USR calls without having to re-type the whole line. At the moment one either makes the correction by re-typing or collecting a few which are then edited using the screen editor.

(4) Graphics Calls

Another criticism which has been made is that the calls are somewhat clumsy — all being of the form Z = USR(J,n,p1,p2,etc.). In some machines this have been avoided by the use of Mnemonics e.g. in Apple, the instruction HPLOT etc. I suppose that there is a little of "what one is used to" about this argument, but I have found no problem in using the calls.

It would be of great advantage to have a cross-reference list of the calls from the different machines to facilitate translation from one machine to another.

(5) Windows

Making use of the 'resolution windows', it is possible to produce an impression of a multi-color high resolution graphic. The high resolution page is normally two color but any low resolution area created within it will be a 16 color area. There is therefore a wide range of possibilities of color even in the high resolution mode.

SAMPLE PROGRAM

I have given one sample program to give some idea of how the system works. I have included many REM statements to improve the readability of the programs.

Continued on next page

Budget Graphics for the Cromemco Z2D

Continued from page

Program 1 The sine wave

This program simply draws the graph of A*SIN(N*X+P). After the graph has been drawn the program then randomly selects foreground and background colors as a demonstration of the range of possible combinations. This is not an integral part of the program. This section is at lines (1790-1970).

Conclusion

The system is fairly comprehensive, straightforward to use and the results are exciting. I have successfully used the graphics in conjunction with the Cromemco D+7A A/D interface — plotting cooling curves for naphthalene and water (temperature measurement by Si-Diode Probe) and charge/discharge curves for a capacitor.

The cost of the system should be looked at in relation to the original outlay for the Cromemco system. It provides a good, expandable graphics capability for a robust, well-proven system.

References

1. SMDP — Scottish Microelectronics Development Programme Periodical Phase Two Vol. 1 No. 2, 1981.
2. Microcentre, 30, Dundas St., Edinburgh.
3. Microvitec, P.O. Box 188, Bolling Rd., Bradford, BD4 7TU.
4. Valley Technology Ltd., 47 Echline Grove, South Queensferry, Scotland.
5. Ayr Division Science Computer Group, Newton Centre, Green Street Lane, Ayr.

List of Programs Completed to Date

Optics:
1. Then Eye (Labeling)
2. Normal Vision
3. Defects of Vision 1. Short Sight
4. Defects of Vision 2. Long Sight

Electrostatics:
1. The Electroscope
2. Determination of charge on a rod
3. Charging by Induction
4. Conservation of charge

Electric Fields:
1. Two unlike point charges
2. Two like point charges (+)
3. Two like point charges (−)
4. One point charge, one charged plate
5. Two parallel plates

Budget Graphics for the Cromemco Z2D

Waves:
1. Reflection of plane waves
2. Diffraction of plane waves
3. Interference of circular waves
4. Addition of two sine waves
5. Fourier addition to produce square wave

Interfacing:
1. Digital thermometer (one range)
2. Digital voltmeter (one range)
3. Plotting of cooling curves
4. Charge/Discharge of a capacitor
5. Z80 Digital thermometer and voltmeter (one range each)

About the Author

Sean Pentleton, B.Sc., is a Principal Teacher of Physics in the School Computer Development Office of St. Michael's Academy at Winton Place, Kilwinning, Ayr Division, Strathclyde, Scotland. Pentleton can be reached by telephone in Scotland at 0294-51564, ext. 43.

In addition to his regular duties, Mr. Pentleton is also Project Organizer for a project on CAL in Physics sponsored by the Scottish Microelectronics Development Program (SMDP). SMDP have provided the hardware and some software for the project and asked him to evaluate this graphics capability for the Cromemco.

He is also Chairman of the Ayr Division Science Computer group which coordinates development of the microcomputer in Science Subjects in that Division.

The Development of a Microcomputer Based Radar System

Continued from page

this reason all software has been written in Z-80 Assembler to produce as efficient a code as possible.

All calculations concerning distances, speed, and course include trigonometrical operations. To increase the speed of these calculations, a 32 bit floating point APU (Arithmetic Processor Unit) is added. Another feature of the APU is that it works independently from the rest of the system.

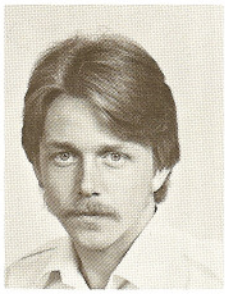
Installation

In those installations where there is no need to store situation pictures/logs on floppy disks, the 16FDC and 64KZ may be substituted with a 32KBS card. This will mean that the system can be operational directly when switched on. System One could be used for those installations where one 48KTP card is sufficient (in connection with SDI). (Figure 3). The radar interface hardware itself consists of two cards. A prototype has at this writing been in operation for a period of approximately four months.

Commercial Evaluation

The above describes in some detail the product and it will be readily seen that not only does it improve present radar installations to a very great extent; it is also an inexpensive improvement.

Possible uses of the SDI radar display include a range of applications for military and other governmental agencies as well as for the industry. Port Authorities should be particularly interested, especially where the traffic is heavy and good monitoring ability is a must. Also the system could be used to great advantage in aviation and on board oceangoing vessels.



About the Author

Mr. Vidar Solli, M.Sc., was born in Trondheim in 1956. After completing his education at universities in Dundee and Trondheim, he worked for a period as a research assistant at the Technical University at Trondheim. A period of 15 months in the Royal Norwegian Navy gave him his first experience with Cromemco computers.

Mr. Solli has his own data consulting firm and is also associated with MICRO SYSTEMS A/S, Norway as a systems engineer.

Further information on implementing radar enhancements can be obtained by writing to:

MICRO SYSTEMS A/S
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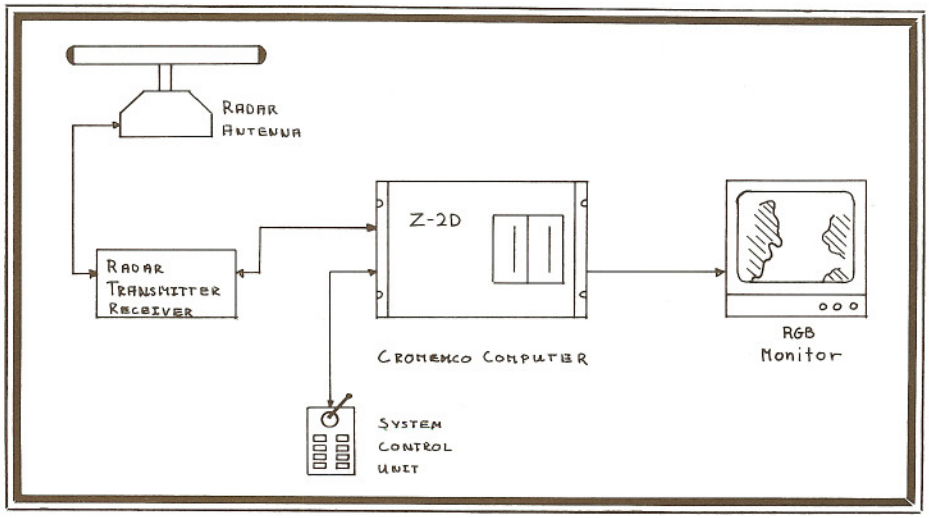
Oslo 1, NORWAY



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Key Personnel: Maurice Gaspard, Ph.D.
Gabriel Gaspard, Ph.D.

Tripoli, Lebanon: Socomet/Bahsas, P.O. Box 214
628-3000
Key Personnel: Moussa Dib, Executive V.P. (Const. Eng.)

Canada: Deerfoot Business Centre, Suite 230, 6715 8th St. NE; Calgary, Alb. T2E 7H7
(403) 275-5871
Key Personnel: John Caron, M.Sc.
Mylo Stromsoe, C.A.
David Lavers, P. Eng.

Consulting engineers; sales & service. On-site or in-house service agreements to the end user. Specializing in structural engineering programs; accounting; word processing. Newport Beach facility is equipped to perform repairs on all Cromemco products. Fast turn-around.

Major Markets: Structural/Petroleum/Industrial engineering; accounting and word processing for the Canadian market.

GLOBAL TECHNOLOGY, INC.
28509 Seamount Drive
Palos Verdes, CA 90274
(213) 325-7037/Telex: 910-696191

California-based import/export corporation specializing in promoting trade of technology, systems, equipment, components and materials for scientific and industrial applications between U.S. manufacturers and the Orient —particularly the People's Republic of China.

Key Personnel: Dr. Lily Wang
Mr. Chung Wang
Ms. Y. Lee

Major Market Area: The People's Republic of China

Continued next page

INFORMATION MANAGEMENT INTERNATIONAL (IMI)
Cromemco Sales Office: **2525 E. Bayshore Road**
Palo Alto, CA 94303
(415) 493-2100

Corporate Office: **1101 S. Winchester Blvd.**
San Jose, CA 95128
(408) 248-8250

Largest overseas distributor of Cromemco products, providing OEMs and systems integrators with hardware and software. Consultants in banking/financial systems, robotics, graphics, medical systems, and communications.

Key Personnel: Bob Blaisdell, Managing Director
Joy Stone, Sales Coordinator
Chris Glon, Technical Advisor
Don Walker, Technical Advisor
Dave Schilling, Medical Systems

Major Market Areas: California, France, Asia. (both sales and service)

LEAR DATA CORPORATION
2401 California Blvd.
Napa, CA 94558
(707) 252-7139

Systems House and full Cromemco dealership in professional, 3,000 square foot office facilities. Separate lab and repair facilities. 24-hour service responses. Provides full warranty service. Drive alignments done in-house. Developers of the Tri-Star, Tri-Dent, and Tri-Med software systems.

Key Personnel: Robert Gustafson, Pres.
Dr. Joseph Nelson, Vice Pres.
Arnold Gold, Mktg. Director
David Bryan, Sr. Systems Analyst

Major Market Area: Software — Nationwide
Hardware — Northern California

MCM ENTERPRISES
459 Hamilton Ave., No. 304
Palo Alto, CA 94304
(415) 493-3333

A full service computer solutions company with consulting, equipment, software, training, and service. MCM carries a full line of Cromemco Systems, Lear Tristar and Serendipity Business Software, and NEC Service Center for Northern California (printers and printing terminals).

Key Personnel: M.C. Merchant, (MSEE) Owner
C. Leighton, Project Manager
G. Nielsen, Service Engineer
S. Evans, (CPA) Bus. Consultant
J. Peckler, (CPA) Bus. Consultant
L. Terry, Acctg. Sys. Consultant
M. Nadaire, (MSEE) Mgr. Paris Office

Major Market Area:
Sales: San Francisco Peninsula extending internationally.
Service: S.F. Peninsula extending into N. California
Paris Office: 4 Rue Paul Bert
92150 Suresnes, France
Tel (1) 506 33 03 TLX 610994F

Reno Office: 1275 Kleppe Lane, No. 14
Sparks, NV 89431
(702) 358-0415
Paris Office: 4 Rue Paul Bert
92150 Suresnes, France
Tel (1) 506 33 03 TLX 610994F

UCI/THE SYSTEMS STORES
ARIZONA
4022 E. Broadway, Suite 112
Phoenix 85040
(602) 255-0700

CALIFORNIA (Home Office)
2520 Mission College Blvd.
Santa Clara 95050
(408) 988-1988

NEW MEXICO
6104 Kircher Blvd., N.E.
Albuquerque 87109
(505) 345-9981

OREGON
5687 S.E. International Way, Ste. 1
Milwaukie 97222
(503) 653-5940

WASHINGTON
14102 N.E. 21st Street
Bellevue 98007
(206) 643-7444

UCI/The Systems Stores are full service distributors of Cromemco Systems and peripheral equipment for Business, Science & Industry.

Managers: Albuquerque — Paul Enz
Bellevue — Doug Pomeroy
Milwaukie — Mary Loring
Phoenix — Sam Kershaw

Mid United States

COMPUTER CENTERS OF AMERICA
2200 Southwest Fwy., Ste. 150 **2629 Stemmons Fw., 215**
Houston, TX 77098 **Dallas, TX 75207**
(713) 527-8008 **(214) 638-4477**

Complete line of hardware and software. Repair on warranty service. Distribution and OEM division. In-house software house with products in system and applications software. Special export department to service foreign dealers.

Key Personnel: Avery More, President (Sales)
Lee Dixon, Dallas Manager
Race Feirman, Houston Manager
Moti Tenenhouse, Technical Director

Major Market Area: Texas, Southwest, Mexico, Middle East

JEPSAN GROUP K, INCORPORATED
4180 44th Street, S.E.
Grand Rapids, MI 49508
(616) 698-8700

Jepsan Group K is an exclusive Cromemco dealer located in a professional office environment with two demo rooms and four Cromemco Systems for use by customers. Extensive service facilities for all Cromemco hardware, including expertise in PerSci drive and IMI disk repairs. Software consultation and customizing, with specialties in accounting and business applications. Developers of *File Management.*

Key Personnel: Phil Schneider, Pres.
John Nordine, Vice Pres.
Ellen Light, Sales Coordinator
Brian Nielson, Service Mgr.

Major Market Area: Sales and Service: Western Michigan
Extended Market Area: Service and Software: U.S. and Canada

COMPUTER SALES, INC.
1700 N. Main Street
Racine, Wisconsin 53402
(414) 634-5558

Full-service computer center with retail showroom, service department and extensive training program as well as in-house software development. Carries full line of Cromemco hardware, software, accessories and literature. Custom

Continued on next page

programming for professionals, retail and manufacturing. Key personnel have strong background in systems analysis and consultation with emphasis on construction, accounting and business applications.

Key Personnel: Fred Cape, President
Ted Witzig, Vice President
Bill Aronin
Fritz Cape

Major Market Area:
Sales & Service: Southeastern Wisconsin
Specialized Systems: Continental United States

TRADEWIND SYSTEMS
Box 96
Liberal, KS 67901
(316) 624-8111, O/S KS 1-800-835-2057

Exclusive Cromemco dealer, specializing in complete business systems. Provides consulting services. Full inventory.

Key Personnel: Clark Stewart, Pres. (business systems)
Wayne Stewart, Vice Pres. (tech./software)
Kevin Elmore, Programmer/analysis

Major Market Area: Sales: S.W. Kansas, extending to Colorado, Kansas, Oklahoma, Texas, New Mexico.
Service: S.W. Kansas

SYNERGISTICS INTERNATIONAL LTD.
35 Fountain Square Plaza, Box 631
Elgin, IL 60120
(312) 695-7775

Full inventory of Cromemco hardware and software. Custom software developed in-house. Vertical market packages available include: Chiropractic Clinics; Architectural Woodwork Job Costing; Social Service Agency Accounting; Auctioneering. Specializing in providing turnkey systems to small and medium sized businesses.

Key Personnel: Jim Knowles, Pres. (Sales)
Gordon Muirhead, Vice Pres. (Software)

Major Market Area: Sales: Chicago and suburbs, extending to entire U.S. and the U.K. Service: Chicago and suburbs.

Eastern United States

COLLINGSWOOD COMPUTER CENTER
1165 Barbara Drive
Cherry Hill, NJ 08003
(609) 429-3838

Medium-sized software house, specializing in small business systems; all models of Cromemco/payroll, billing, mass mailer. Provides warranty service also contract and hourly service.

Key Personnel: Jim Lenz, Pres. (Software design & development)
Deborah Lenz, Vice Pres.
Ken Peacock, Service Mgr.

Major Market Area:
Sales: New York to Washington, extending to entire U.S.
Service: Metro Philadelphia extending to Eastern Corridor.

COMPUTER SYSTEM & TECHNOLOGY, INC.
21-55 44th Road
Long Island City, NY 11101
(212) 937-2900/Telex: 910-429418 CSTNY

Involved in computer business since 1979. Key personnel have strong background in engineering, software development, financial markets and import/export trade. Provides consultation and custom-made programs for governments, manufacturers, wholesalers, retailers and professionals.

Key Personnel: Mr. Mike Fung, Vice President
Ms. Fanny Ho, Manager
Ms. Salina Ho, Systems Analyst

Major Market Area: New York, China, Hong Kong and Iceland

COMPUTER SYSTEMS FOR SMALL BUSINESS
42 West Ivy Lane
Englewood, NJ 07631
(201) 568-7602

CSSB is a small service bureau and software house using Cromemco hardware combined with proprietary custom software. Software applications packages include PAYROLL, ACCOUNTS RECEIVABLE, SALES ORDER ENTRY WITH INTEGRATED INVENTORY, GENERAL LEDGER, and MAILING LISTS. Packages are expandable, but current average user has 200 active employees, 1500 customer accounts, 6000 open invoices, & 7500-part inventories. CSSB installs and maintains Cromemco systems as an OEM. Other services include custom business programming, consulting, and on-site training.

Key Personnel: Coley Brown, President

Primary Market Area: Hardware Sales & Service — New Jersey & Southern New York State. Software Licensing & Service — U.S., Canada & Mexico.

CUSTOM COMPUTER SPECIALISTS, INC.
208 Roanoke Avenue
Riverhead, NY 11952
(516) 369-2199

Full service systems house with retail showroom. Full line of Cromemco hardware, software, accessories, and literature. Provides warranty service, diagnostics, consultation, systems analysis, and custom programming. Special management software for attorneys, mass transportation scheduling, reservations, delivery manifests, education, small businesses. School rentals, teacher training.

Key Personnel: Gregory G. Galdi, Pres.

Major Market Area: Sales: Northeast U.S., extending to East Coast
Service: East Coast extending to Continental U.S.

DIGIBYTE SYSTEMS CORP.

31 East 31st Street
New York, NY 10016
(212) 889-8130

480 Lexington Avenue
New York, NY 10017
(212) 687-5090

Complete computer center housing a full line of Cromemco hardware and software. Special services include installation, warranty service, and customer education. Large selection of Cromemco software packages as well as custom programming for business and professional applications.

Key Personnel: Robert Silverman, Pres. (software)
Barry Becker, Vice Pres. (hardware)

Major Market Area: Service — Primarily East Coast.
Sales — Worldwide

Continued on next page

METROPOLITAN COMPUTER
110 Harvard Street
Brookline, MA 02146
(617) 277-5115

A full service and support dealership committed to a full line of Cromemco products. Service offered on both an hourly basis and by contract, and includes custom-designed hardware and software for individual interfacing needs as well as communications applications. Complete Cromemco line on display and available for hands-on demonstration, including color graphics system.

A wide range of software including all Cromemco software is available. Dealership specializes in word processing, accounting packages and data base systems. A full-time engineering and sales staff is maintained for customer support.

Key Personnel: Frederick S. Lebow, President (Engineer)
Dwight Calhoun, Director of Engineering
Melissa Lavers, Sales Staff
Eugene Cimino, Sales Staff
C. Eugene Jones, Sales Staff
Karen Greenberg, Sales Staff

Primary Marketing Area: Massachusetts
Extended Marketing Area: New England States

ROYAL DATA, INC.
2203 Garden Street
Titusville, FL 32780
(305) 267-1960 269-3116

A full-service computer sales and support organization. More than 22 years comprehensive applications experience in process control, telecommunications and office automation. Complete Cromemco line in stock, including Graphics systems.
Featuring manufacturing inventory control, Bill of Materials, Accounting Plus software, Lear Data Tristar dental and general business software. Custom development for real-time data acquisition and control. Emulator support of virtually all CP/M software under CDOS and CROMIX.

Key Personnel: Jency Kelly, Pres. (sales & marketing)
Mark Clough, Sales Engineer
Bill Hardin, Repair and Maintenance
Charles Brossier, II, Technical Software Support
Jean C. Kelly, Office Manager

Major Market Area: Southeast Florida

Mexico

SOPORTE ADMINISTRATIVO COMPUTACIONAL, S.A.
15 De Mayo #1111 PTE
Monterey, N.L. Mexico
43-83-40

Complete line of Cromemco hardware and software in inventory. Specializing in the educational field. Full service facility, providing technical consulting, as well as warranty repair service.

Key Personnel: Juan Angel Perez, Director (systems)
Jaime Martinez, Customer Support (MSEE)
Gerardo Elizondo, Technical Mgr. (MSEE)

Major Market Area:
Sales & Service: Internationally, primarily Mexico

MICROMEX, S.A.
Aldama No. 78
Mexico, D.F. 04100
554.75.75, 554.27.42

Full service company. Complete line of Cromemco equipment with sales agencies in Mexico City, Monterrey, Guadalajara, Tampico, Veracruz, San Luis Potosi, Coatzacoalcos and Torreon. Emphasis on complete computer solutions for small and medium-sized companies. Warranty and regular service available.

Key Personnel: Dr. Enrique Grapa. General Manager
M.C. Angel Kuri, Hardware Director
Ing. Pedro Excarcega, Softare Director
C.P. Louis Antonio Sandoval, Administration Director
Marcos Ortiz, Sales

Major Market Area: Sales & service: Latin America, primarily in Mexico and Central America.

South America

EPROM LTDA.
Antonio Bellet 226, #704
Casilla 16494, Correo 9
Santiago
Chile
740910/Telex: 359-94436 PBVTR KU

Eprom is a consulting firm which specializes in software development for business applications and process control in industries. Computer marketing of the company is limited to CROMEMCO systems.

Key Personnel: Jorge Bellet, Sr. Executive
Eliana Ferrada, Administrator
Friedmut Ballek, Sr. Engineer

Major Market Area: Most of Chile. Local service is now being offered in Santiago, Valparaiso, Concepcion and Africa.

PERSOCOM
Av. Corrientes 447, Piso 7°
1043 Buenos Aires
Argentina
011-541-394-1913/Telex: 390-17341 ITEL-A RMMM

Persocom SA is the holding company of Plus Computers SA. Plus is marketing a full line of CROMEMCO products along with other IBM-compatible products.

Key Personnel: Esteban Gimenez Vives, President, General Manager
Raul Manuel Avila, Director of Operations
Roberto Boldrini, Director of Technical Support

Major Market Area: All of Argentina, with special emphasis in the Buenos Aires area.

Continued next page

International

England

DATRON MICRO-CENTRE
2 Abbydale Road
Sheffield, England
0742-585490 / Telex: 547-151

Main importer, sales and support to dealers and direct, Europe wide. Full Cromemco range. Standard software & consultancy for special applications. Experienced in customized hardware and device drivers and provides warranty and duration service.

Key Personnel: Ian Dunkley, Director (sales)
Dave Rotherham, Software Specialist
Alan Deeley, Hardware and Configuration
Paul Waring, Civil Engineer

Major Market Area: United Kingdom, Europe

COMART LIMITED
Little End Road
Eaton Socon
St. Neots, Huntingdon
Cambridgeshire PE19 3JG
UNITED KINGDOM
(0480) 215005/Telex: 851-32514 COMART G

Dynamic UK distributor—20,000 sq. ft. warehouse. Full CROMEMCO range of hardware, software, and peripherals for stock, demo and training. Nationwide network of dealers. Sales, plus full hardware and software support. Warranty service, plus maintenance and service repair at nationwide and local levels. Extensive testing and development facilities.

Key Personnel: David Broad, Managing Director
John R. Lamb, Marketing Director
David Fear, Sales Director
Peter Webster, Product Marketing Mgr.

Major Market Area: Nationwide UK and Eire

Ireland

LENDAC DATA SYSTEMS, LTD.
8 Dawson Street
Dublin 2, Ireland

Suppliers and supporters of the full range of Cromemco Computer Systems and software.

Key Personnel: Don Lehane, Director, BSC (Computer Science)
Danny McNally, Director, BSC (Computer Science)

Major Market Area:
Sales & Service: Throughout Ireland

Europe

AGRO MARKETING
B Adzije 7/1, 41000 Zagreb
Yugoslavia
41 417-662 Telex: 2141yuam

Large full-service facility, with complete line of Cromemco products and proprietary software. Specializing in software development, interfacing, and special medical computerized equipment.

Key Personnel: T. Raguz, Director (Marketing)
N. Ivancic, Software Manager
B. Krtolica, Customer Support (Hardware)

Major Market Area:
Sales & Service: Internationally, primarily Yugoslavia

COMPUTEC BENELUX, B.V.
Prunellalaan 3
P.O. Box 128
5580 AC - Waalre
The Netherlands
31-04904-5865/Telex: 844-59175

Computec Benelux is a "daughter" of The Vollwood Organization, a holding company with working companies in many European countries. Active in selling business-type applications where CROMEMCO hardware, with a wide choice of terminals, is provided to OEM'ers and subdealers. Specializes in hardware maintenance and adaptations in the hard software.

Key Personnel: Mr. H. Oosterveer, Purchasing, Vollwood
Mr. M. Scheller, Germany
Mr. J.W. Rozema, The Netherlands

Major Market Area: Major Market Area: Germany and the Netherlands

C.T.A. COMBITEXT AUTOMATION
Klein Loolaan 23
3972 KB Driebergen
The Netherlands
03438-17777/Telex: 844-40444 dfe nl

A leading company in the Benelux, in the micro computer market. Represents CROMEMCO computers in these countries. CTA specializes in selling to OEM's, large computer users, and self-programming customers. End-users are supplied with application software via CTA software houses.

Key Personnel: P.H.J.M. Haffmans, Managing Director CTA Int'l
N. Van Den Bosch, Managing Director CTA Computers
F. Arnolds, General Manager/Software

Major Market Area: The Netherlands

DIALOG COMPUTER SYSTEME GMBH
Frankfurter Allee 1-3
6236 Eschborn
West Germany
06196-46060/Telex: 841-415601 TELEP D

CROMEMCO distributor for the BRD, with a large full hardware-service capability. Offers software support to the CROMEMCO software packages. Primarily serves system and software houses.

Key Personnel: Mr. M. Scheller, Managing Director
Mr. W. Krainski, Techn. & software sales support
Mr. W. Moos, Service Manager

Major Market Area: Primarily West Germany

UNICOMP SPA
via fratelli gracchi, 48
20092 cinisello balsamo (milano)
(02) 6121041 (5 linee r.a.)

Inventories complete line of Cromemco hardware and software in Italy, with a market extending into Greece. A four-year-old distributor firm, Unicomp offers sales and support of the full Cromemco line for business, scientific and industrial applications.

Key Personnel: P. DiCamillo, Managing Director
S. Focardi, Sales Director
F. Montanari, Systems Manager
A. Capocchi, Service Manager

Major Market Areas: Italy, Greece Continued next page

Mediterranean

COMPUTER APPLICATIONS COMPANY, LTD.
29 Arcadias Street
Athens 608, Greece
779-8868 or 778-7708

The exclusive Cromemco distributor in Greece, Coputer Applications Company, Ltd. specializes in applications relating to the proprietary software it has written for Civil Engineering, Shipping, and Hotel industries.

Key Personnel: Dennis Ioakim
Theocharis Vafiopaulos

Major Market Area: Greece

Middle East

REALTIME ENGINEERING & DATA ANALYSTS
P.O. Box 278
Dhahran Int'l Airport
Dhahran, Saudi Arabia
(966) (3) 8649043/Telex: 928-670480 READAK SJ

P.O. Box 6156
Jeddah
Saudi Arabia
(966) (2) 6531502

Sales and maintenance of computers, peripherals and supplies within the areas of automation, industrial, business and office. Security systems. Strong in developing ARABIC SYSTEMS (hardware and software) and turnkey projects. Large simulators and facsimile.

Key Personnel: A.A. Salamah, Administrative Director
Nasir Jamil, Manager Digital Systems Div.
Ziyad Ismail, Software Design and Development

Major Market Area: Master CROMEMCO distributor for Middle East (Saudi Arabia, Gulf Emirates, Iraq, Syria, Jordan, Lebanon)

Far East

ASAHI GLASS
Electronics Group
Special Products Marketing Div.
1-2 Marunouchi, 2 Chome
Chiyodaku, Tokyo 100
Japan
Telex: 24616 ASAGLAS

Complete line of Cromemco hardware and software in inventory. 700 sq. foot training room. Specializing in O.S. modifications. Full service facility, providing technical consulting as well as warranty repair service.

Key Personnel: Shigeo Satoh, General Manager (systems)
Norimasa Hori, Manager (sales)
Shinichi Watanabe, Tech/software

Major Market Area: Japan

COMPUTER SHOP
JL. DR. Wahidin No. 11
Jakarta, Indonesia
62-21-355868

Complete computer center housing a full line of CROMEMCO hardware and software. Special services include installation, warranty service, and customer education. Separate lab and repair facilities specializing in software development for Indonesia.

Key Personnel: Renaldi Z.K., Managing Director
Veny Zano, Service Manager
Anton, Software design & development
U.L. Permadi, System design

Major Market Area: Stores in Jakarta, Bandung, Surabaya, and Medan, Indonesia.

INDONESIAN COMPUTER ENTERPRISES
JL. Juanda No. 87
Bandung, Indonesia
62-22-81995/Telex: 28360 AC BD

Complete computer center housing a full line of CROMEMCO hardware and software. Special services include installation, warranty service, and customer education. Separate lab and repair facilities specializing in software development for Indonesia.

Key Personnel: Renaldi Z.K., Managing Director
Veny Zano, Service Manager
Anton, Software design and development
U.L. Permadi, System design

Major Market Area: Stores in Jakarta, Bandung, Surabaya, and Medan, Indonesia.

NCC INTERNATIONAL
Matsunaga Building 1-6-6
Sotokanda Chiyodako
Tokyo, Japan
03-255-1984/Telex: 781-2523758

The oldest Japanese microcomputer store of the Byte Shop chain, offering CROMEMCO to Japan since 1977. This company primarily sells CROMEMCO equipment, and provides high technology and comfortable customer service.

Key Personnel: Kiyoake Ikeda
Toshinori Yamamoto
Ryuichi Kawase

Major Market Area: Japan

REC EMSCO
51-52 Haiphong Road
Kowloon, Hong Kong
3-685211/Telex: 84617 EMSCO HX

Electronics and computer distributors.

Key Personnel: Peter Chan
Raymond Watt
Robert Chiu

Major Market Area: China and Hong Kong

Continued next page

SYMBOL ENTERPRISE CO., LTD.
8th Fl. Formosa Plastic Bldg.
New Wing, 201-18 Tunghwa North Road
Taipei, Taiwan
Republic of China
01-722-2777/Telex: 785-22559 BAYFLOW

Symbol Enterprise and its associate, Bayflex Computer, are CROMEMCO computer distributors. They provide the sale and maintenance of hardware, as well as software programming, data processing, and computer programming in Chinese.

Key Personnel: Hurdy J.W. Su, Executive Vice President
Ju-Jer Yang, Vice President
Shu-Ching Kuo, Senior Programming Engineer

Major Market Area: Major Market Area; Taiwan, Republic of china

TIEN SHENG ENTERPRISE CO., LTD.
30 Hoping West Road, Third Floor
Section 1, P.O. Box 30 518
Taipei, Taiwan
Republic of China
02-392-2284-56/Telex: 785-22842 TIENSHEN

One of the largest importer/exporters of computer business/industrial control systems in Taiwan. With several years of computer engineering experience, Tien Sheng provides turnkey basis and reputable service.

Key Personnel: Mr. R. Sheu
Mr. C.K. Cheng
Mr. M.S. Hu

Major Market Area: Taiwan, Republic of China

Australia

INFORMATIVE SYSTEMS PTY. LTD.
337 Moray Street, South Melbourne,
Victoria, Australia 3205

Full range of Cromemco, retail and wholesale computer store. Provides full sales and service, specializing in education and small business applications.

Key Personnel: Dr. Simon Rosenbaum, Gen. Mgr.
Ian Savicky, Tech Advisor
Norman Rosenbaum, Sales Mgr.
Mark Coulthard, Engineer

Major Market Area: Sales & Service: Throughout Australia

CD

Current Versions of Cromemco Software

Package	Version	Date Master Created
Accounts Payable	02.65	01/11/82
Accounts Receivable	02.65	01/11/82
'C' Compiler	05.00	03/11/81
Cromemco Diagnostic System	00.09	12/09/81
Overlay Linker	01.16	11/12/81
CROMIX	11.09	05/24/82
DBMS/DBR	03.05	01/08/81
Dazzler Graphics	00.09	07/07/80
CDOS	02.52	05/17/82
Macro Assembler	03.08	01/27/82
16K Extended BASIC	05.70	04/27/81
COBOL Compiler	04.01	12/01/80
FORTRAN IV	03.42	09/15/81
RATFOR	01.05	09/15/81
General Ledger System	02.65	01/11/82
IOP Development System	02.01	11/19/81
Inventory System	02.65	01/11/82
KSAM	01.00	01/25/82
LISP	01.07	08/15/80
RBTE	01.06	11/13/81
Super Dazzler Graphics	01.08	07/10/80
SlideMaster	02.03	11/16/81
SpellMaster	01.05	10/26/81
32K Structured BASIC	03.65	04/24/81
Word Processing System	06.00	01/08/81
WriteMaster	00.46	01/14/82

Join Now. But Don't Cut The Page. Copy This Application and Mail to IACU With Your Check.

Application for Membership

Please start my Membership in the International Association of Cromemco Users right away. I have enclosed my
( ) Check ( ) Money Order in the amount of
$_____ for a ( ) year membership.
(U.S. Dollars only please)

☐ International applicants: add $10.00 (U.S.) if you prefer to pay through your local bank.

Membership Rates in the United States:
( ) 1 yr. = $35.00 ( ) 2 yr. = $65.00
( ) 3 yr. = $90.00

Membership Rates in Canada and Mexico:
( ) 1 yr. = $41.00 ( ) 2 yr. = $77.00
( ) 3 yr. = $108.00

Membership Rates in all other countries:
( ) 1 yr. = $48.00 ( ) 2 yr. = $81.00
( ) 3 yr. = $129.00

Name: _____

Title: _____

Company: _____

Mailing Address: _____

_____

City: _____ State: _____

Country: _____ Zip/Postal Code: _____

Phone: _____ _____ _____
Area code number extension

Telex: _____

Now Available in the U.S. and most other countries on your VISA or Mastercard
(U.S. Dollars drawn on U.S. banks only **please**. Please Type or Print Clearly)
( ) VISA/Mastercard _____
(Expiration Date)

_____
(Your Full VISA or Mastercard Number)

Date _____ Signature _____

_____
(Name exactly as it appears on card)

The International Association of Cromemco Users is designed to provide its Members with the information they want. Help us deliver by answering the following questions. You may check more than one block as applicable: My field is:

( ) Professional Services ( ) Engineer: _____
(Accounting, Dentist, Law Medicine, Other _____) (please specify)
( ) Home Use
( ) Wholesaler or Distributor ( ) Retail Business
( ) Educational Institution ( ) Government:

_____ _____
(indicate level) (indicate branch)

Effective dates: June 1, 1982 through May 31, 1983

My Primary Uses are:
( ) Business
( ) Business & Personal
( ) Educational
( ) OEM
( ) Personal Only
( ) Process Control
( ) Other: _____
( ) _____
( ) _____

I Want to Know More About the following Packages:
( ) Accounting
( ) Educational (adult)
( ) Educational (child)
( ) Computer Graphics
( ) Inventory Control
( ) Investments
( ) Home Economics
( ) Medical Research
( ) Process Control
( ) Sports & Games
( ) Other: _____
( ) _____
( ) _____

Describe Your Present System: (use brands and model numbers)
Computer: _____
Memory: _____
I/O: _____
Disk: _____
Terminals: _____
Printers: _____
Other: _____
_____

List Software Now in Use: (Packages, Special Operating Systems, etc.)
_____
_____
_____
_____

What Types of Software Would You Like to know more about?
_____
_____
_____

Would you be interested in preparing an article of interest to members?
☐ Yes
Subject Matter: _____
_____
_____

☐ I've included an additional $8.95 for my reference binder (including first class postage in U.S., Canada & Mexico. International purchasers, please add $2.00 [U.S.] extra for postage.)
☐ Please send information pertaining to my exclusive IACU group insurance privileges (U.S. only)
☐ Reserve a Periodic Software Applications Guide for me at the Members-only pre-publication price (to be announced prior to publication).

Mail Your Membership Application to:
The International Association of Cromemco Users
P.O. Box 17658, Irvine, CA 92713 U.S.A.
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DT

Displays and/or sets CDOS date and time. The time function requires a hardware real time clock, such as that built into the Cromemco 3102 terminal, or any other hardware clock, with appropriate I/O software. This program is much faster than Cromemco's STAT/DT for setting and/or displaying CDOS date and time.

DumpRCD

Provides an ASCII/Hex dump of CDOS file records. Similar to Cromemco's DUMP, with the following additional enhancements: display record-at-a-time or continuous ascending display; start dump at any desired file

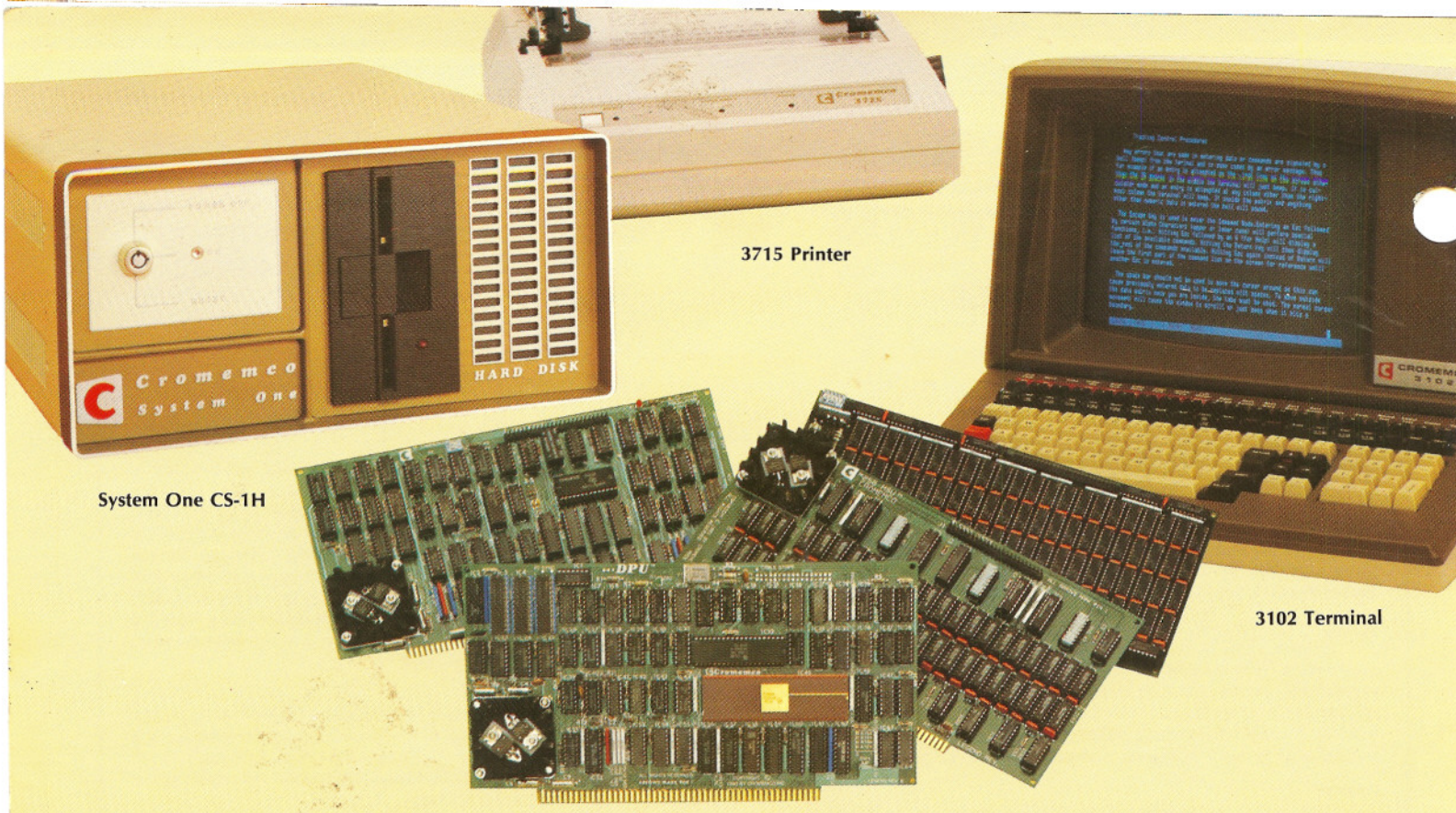
or word processor but at up to 50 times the speed, with the additional advantage of small command file size (6 Kbytes), and the ability to print all or selected portions of a file. Most users of Read.Com rarely use the CDOS "TYPE" command.

Replace

Provides rapid, trouble-free search and replace of any desired ASCII string in any CDOS file. Useful for customizing or changing sign-on messages, version numbers, etc.

Sdt

Similar to Pdt, but for use with serial daisy-wheel printers such as the



3715 Printer

System One CS-1H

3102 Terminal

DPU card with error-correcting memory and controller cards

POWERFUL NEW MICRO. POWERFUL SOFTWARE.

68000-POWERED FOR TOMORROW

Once again you get a big stride forward with Cromemco.

This time it's our new DPU Dual Processor Unit. It gives enormous power to Cromemco computer systems such as our System One shown here.

COMPARES WITH MAINFRAMES

With the new DPU you get the almost unbelievably powerful 68000 processor and its 32-bit data-handling capabilities combined with its **16 Megabyte** address space.

In other words with the System One/DPU combination you get a small machine that's the equal of superminis and mainframes in some areas.

8-BIT AND 68000 SOFTWARE

The dual part of the DPU refers to its on-board Z-80A processor. With this you have access to existing CP/M* software.

But besides being compatible with this wealth of existing 8-bit software, the System One/DPU has available a whole family of new 68000 system software. This includes a wide range of high-level software such as our 68000 Assembler, FORTRAN 77, Pascal, BASIC, COBOL, and C.

Beyond all this there's a version for the 68000 of our widely admired CROMIX† Operating System. It's like UNIX‡ but has even more features and gives multi-tasking and multi-user capability. In fact, one or more users can run on the Z-80A processor while others are running on the 68000. Switching between the Z-80A and 68000 is automatically controlled.

The System One itself is a bus-oriented machine that has options for color graphics, for 390K or 780K of floppy storage, a 5 MB hard disk option, communications capability, and multi-processor capability using our I/O processor card.

HIGHLY EXPANDABLE

With the System One/DPU combination, you get tremendous expandability. Right now you can have up to 2 MB of RAM storage. You get this with our new Memory Storage cards and our Memory Controller. The Controller fully supports the 16 MB storage space of the 68000, allowing you vast future expansion capability.

Further, the memory has built-in **error detection** and **correction,** a feature normally found only in much more costly systems.

Present customers can field-upgrade their Cromemco systems to use the DPU and still be able to run their present software using the Z-80A on the DPU. It's one more instance of Cromemco's policy of providing obsolescence insurance for Cromemco users.

LOW PRICED

With all this performance you might not be ready for the low price we're talking about. With 256K of RAM and 780K of floppy storage, the price of the System One/DPU is only $5495. Yes, that's hard to beat.

So contact your rep now. He'll fill you in on the many more features that this outstanding and powerful machine offers.

*CP/M is a trademark of Digital Research
†CROMIX is a trademark of Cromemco, Inc.
‡UNIX is a trademark of Bell Telephone Laboratories

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